

The first speaker is Mayly Sanchez

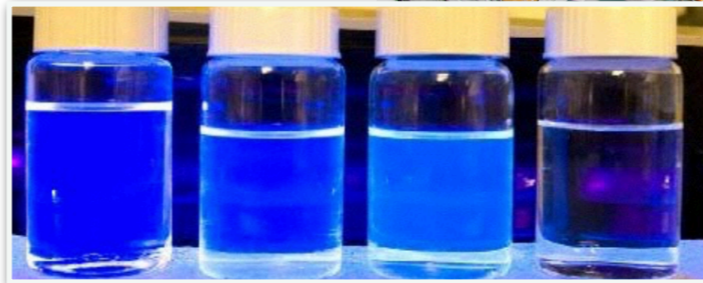
*ANNIE and the Future of Hybrid Neutrino Detectors*

# ANNIE and the Future of Hybrid Neutrino Detectors

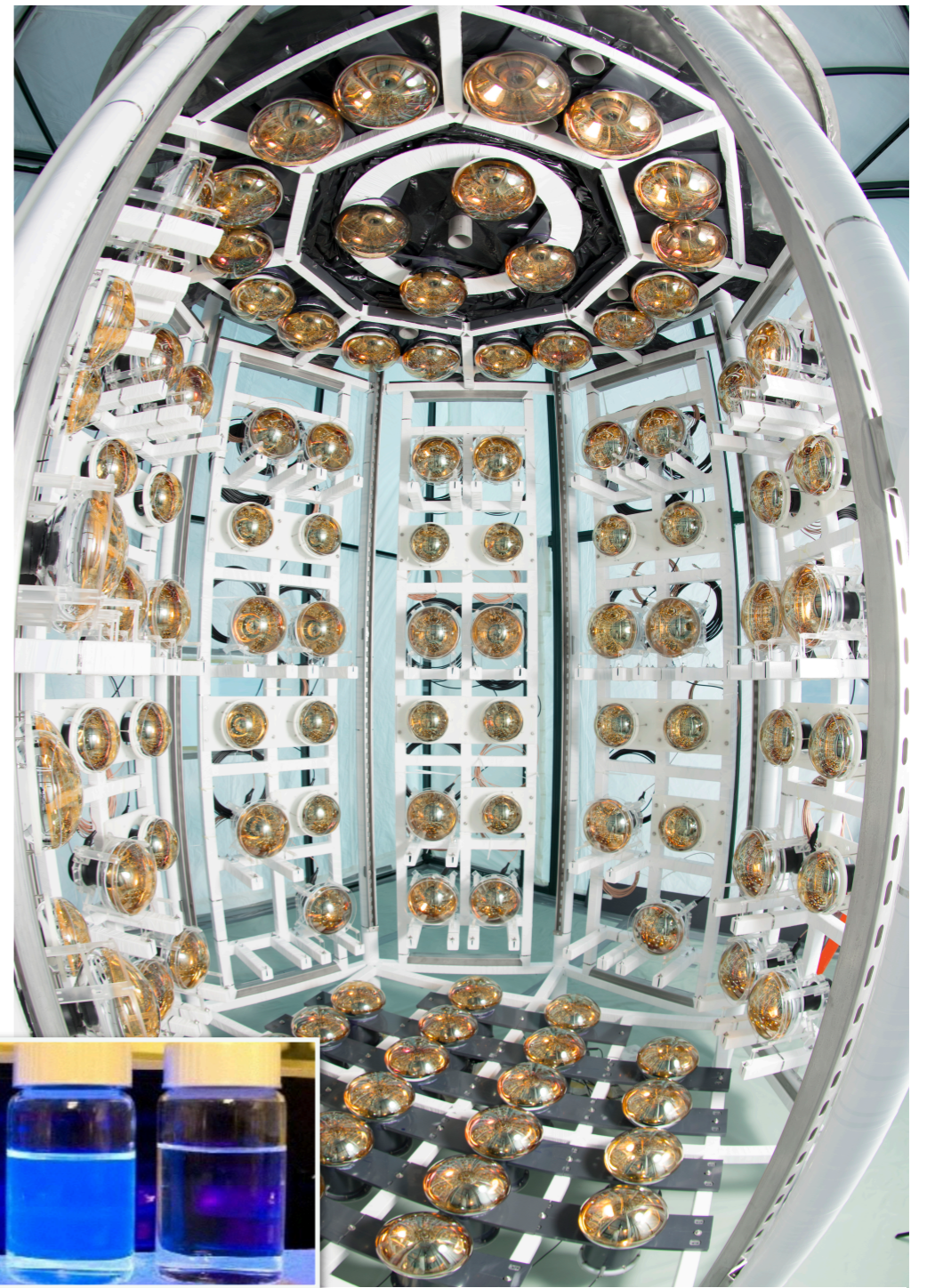
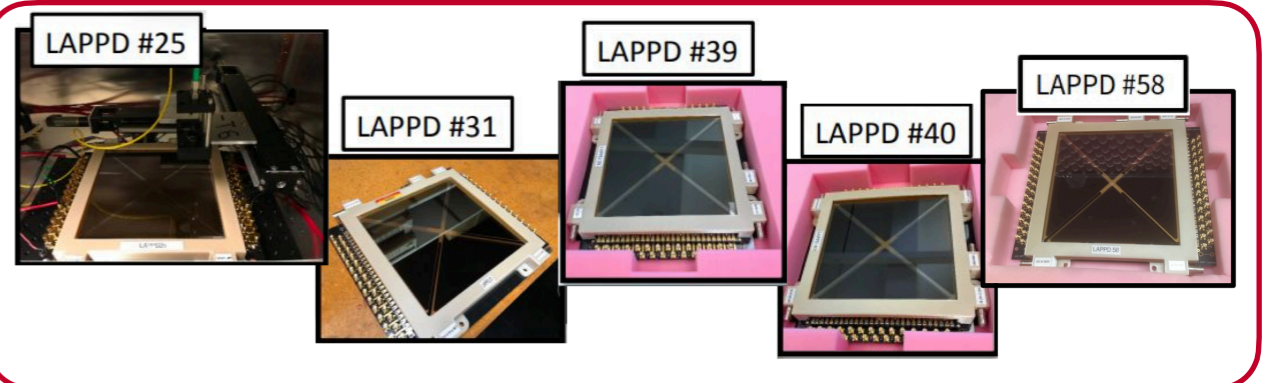
Mayly Sanchez - Iowa State University -  
for the ANNIE Collaboration

- ANNIE can be the first step in the development of hybrid (Cherenkov plus Scintillation) optical detectors by replacing the current gadolinium-water target with Water-based Liquid Scintillator (WbLS) and increasing the coverage of LAPPDs offering new detection capabilities.
- This is a critical step towards demonstrating the power of hybrid detectors for a new generation of far detectors in long-baseline neutrino oscillation experiments and observatories for low-energy neutrinos.

WbLS



ANNIE LAPPDs



Thank you for your town hall contribution.

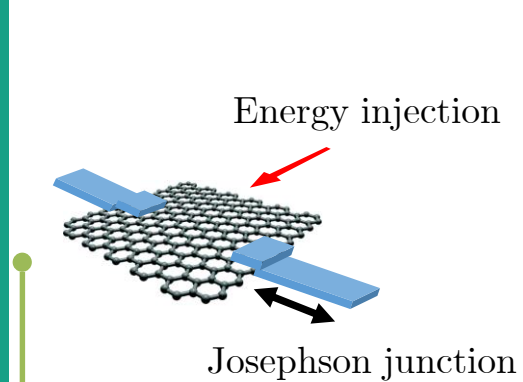
The next speaker is Doojin Kim

*Detecting keV-range super-light dark matter using  
graphene Josephson junction*

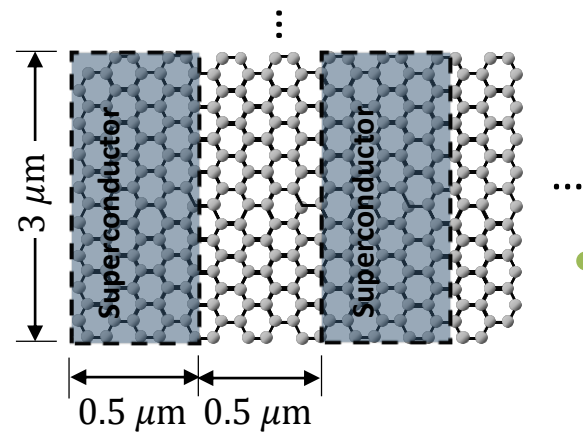
# Detecting keV-Range Super-Light Dark Matter Using Graphene Josephson Junction (GJJ)

Doojin Kim [doojin.kim@tamu.edu], Texas A&M University  
DK, J.-C. Park, K. C. Fong, G.-H. Lee,  
PRL under review, [arXiv:2002.07821](https://arxiv.org/abs/2002.07821)

(a) Detection principle



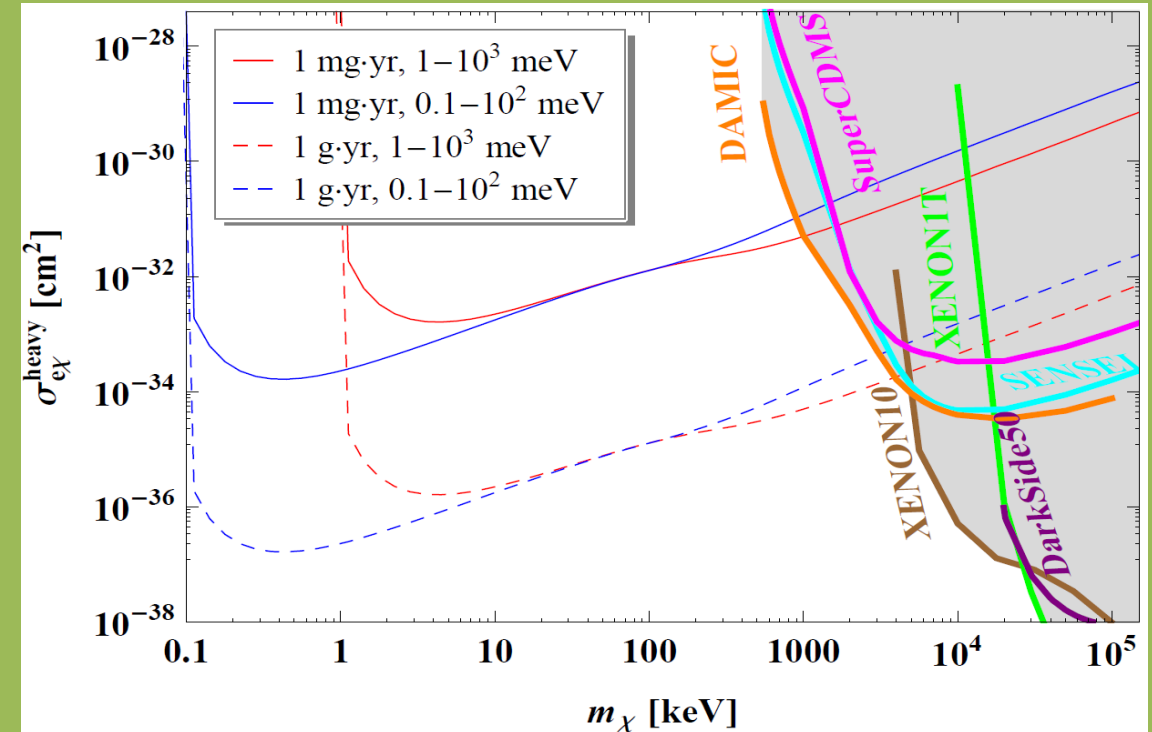
(b) DM detector



Sensitivity to  $E \sim 0.1$  meV energy deposit demonstrated experimentally  
[Nature 586 (2020) 42, [arXiv:1909.05413](https://arxiv.org/abs/1909.05413)]

GJJ DM detector capable of detecting DM with its mass being greater than  $m \sim 0.1$  keV

Scattering between DM moving in 3D space and free **electrons confined in 2D** graphene layer – signal rate **depending on the DM direction**



□ GJJ DM detector improving the minimum detectable mass by **more than 3 orders of magnitude** over the ongoing/existing experiments



## Future plan & further applications

- **First keV-scale DM detection experiment** using the pre-fabricated sample devices
- Applications to detecting **meV-scale dark photon/axion** by absorption and observing **cosmic neutrino background**

Thank you for your town hall contribution.

The next speaker is Rebeca Gonzalez Suarez  
*Searches for Long-Lived Particles at the FCC-ee*



# Searches for Long-Lived Particles at the FCC-ee



► Author: **Rebeca Gonzalez Suarez** 

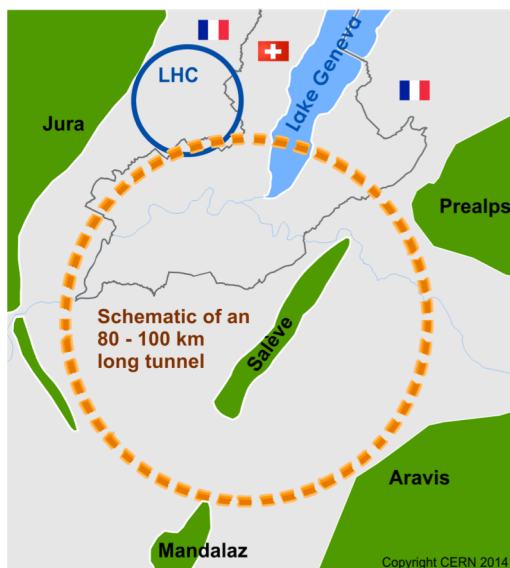
► Co-author: Patrizia Azzi



**Lol**

Not only a precision tool!  
Many BSM Opportunities

**FCC-ee**  $e^+e^-$  circular collider  
Higgs, EW, top and Flavor factory



possible first step towards FCC-hh  
Large Energy range (Z, W, tt, H)

Dark Matter,  
Baryon Asymmetry  
of the Universe,  
Neutrino Masses

Unusual  
signatures  
  
Innovative  
experimental  
solutions

**Long-Lived particles!**

(e.g: Heavy Neutral Leptons, Axion-Like-Particles)

Thank you for your town hall contribution.

The next speaker is David Hertzog

*Testing Lepton Flavor Universality and CKM Unitarity  
with Rare Pion Decays*

# PiENuXE: Testing *Lepton Flavor Universality* and *CKM Unitarity* with Rare (stopped) Pion Decays – David Hertzog (UW)\*

## • Goals

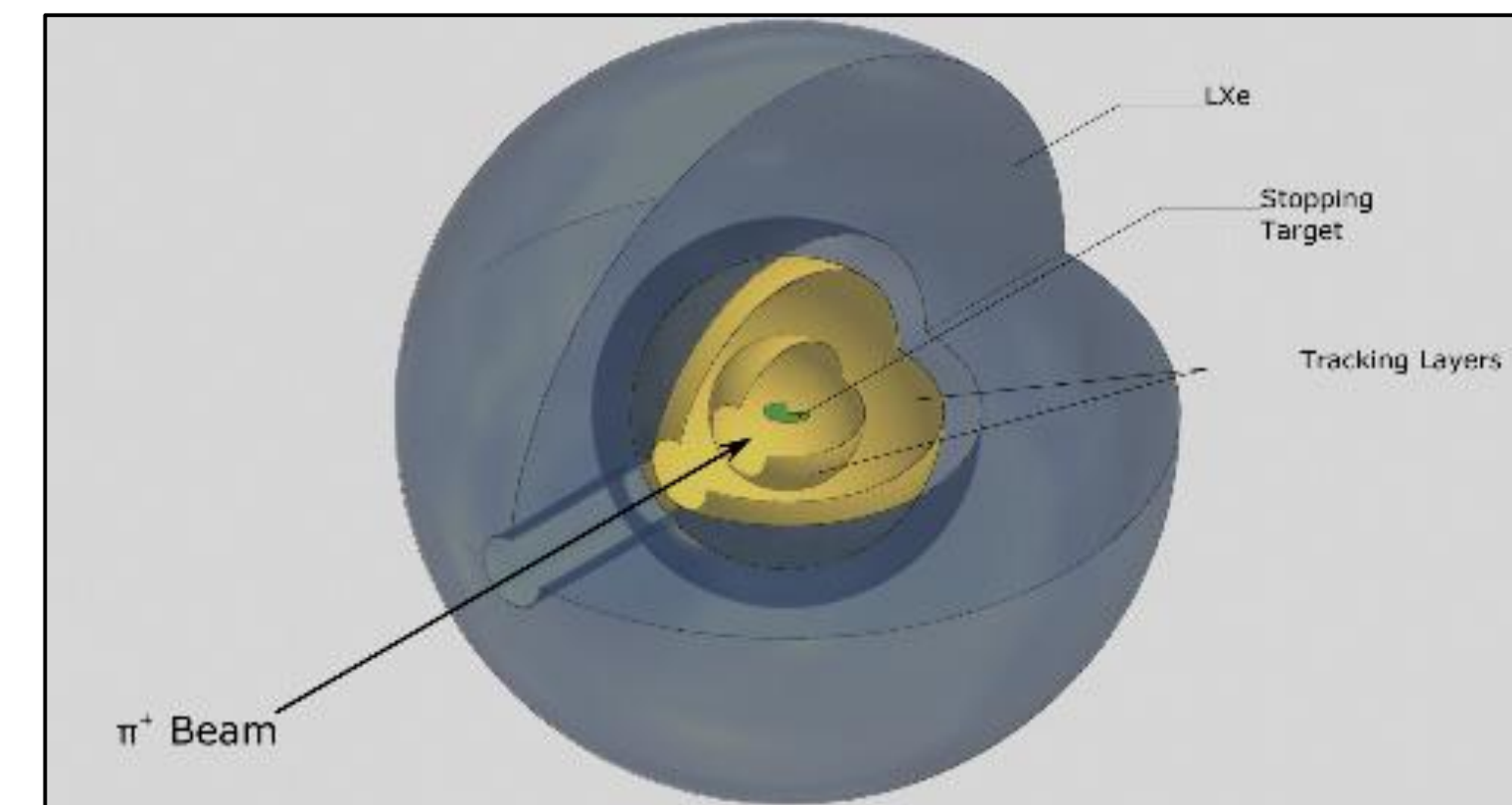
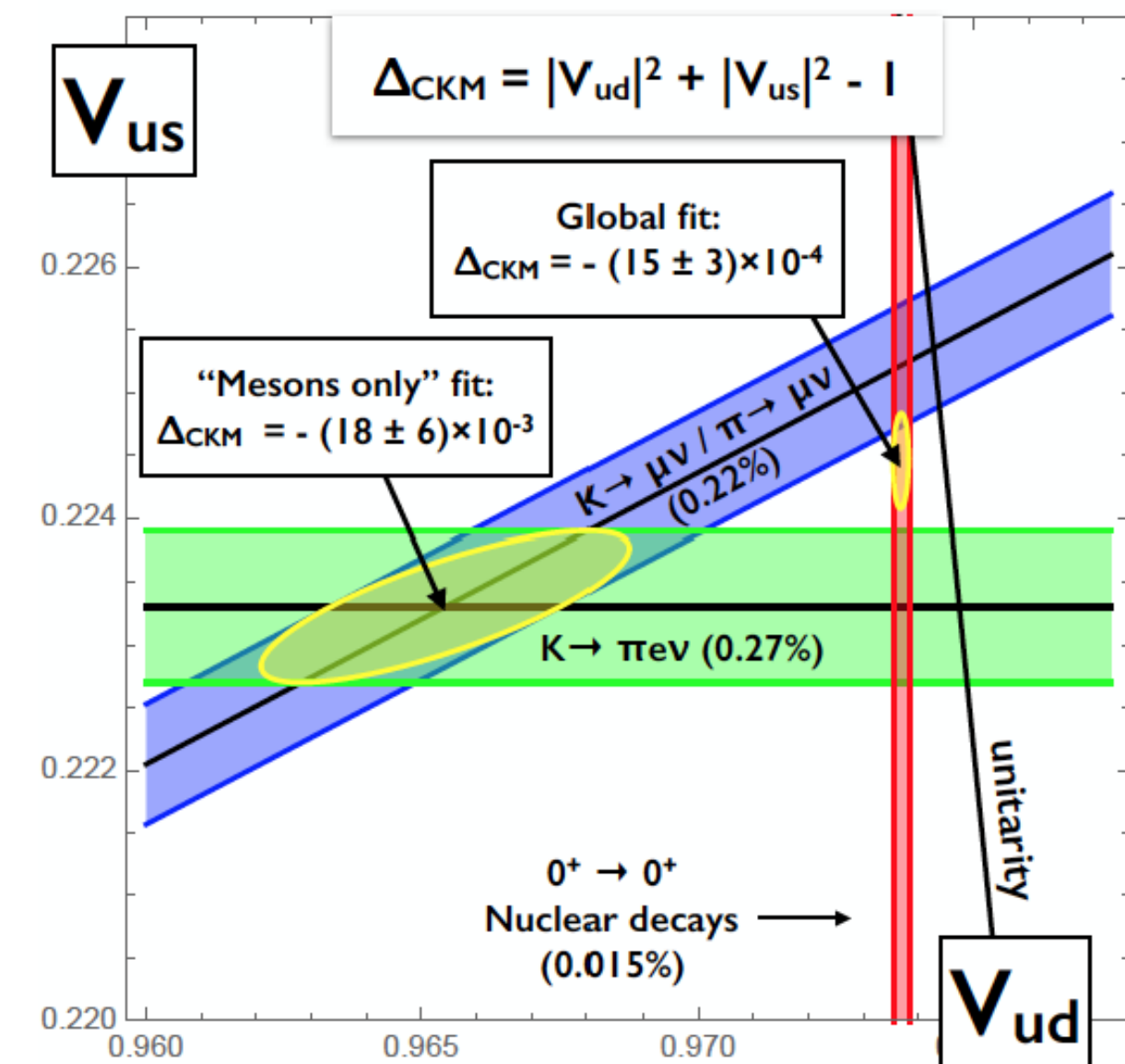
- Improve  $e/\mu$  universality and CKM unitarity tests by an order of magnitude
- Measure  $\pi \rightarrow e\nu/\pi \rightarrow \mu\nu$  to  $\pm 0.015\%$ , matching SM theory precision
- Measure pion beta decay rate to  $\pm 0.06\%$ 
  - Leads to  $V_{us}/V_{ud}$  constraint to  $< 0.1\%$

## • Motivation drawn from

- Possibly related tensions from  $(g-2)_{\mu,e}$ , CKM unitarity, and  $B$  decays
- Possibility that the apparent violation of CKM unitarity is a manifestation of Lepton Flavor Universality Violation (LFUV). (PhysRevLett.125.111801, Sept 2020)
- Precise theory, experiments far behind in comparable precision

## • How

- Next-gen design based on real-world lessons from PEN and PiENu
- $28X_0$  LXe/SiPM – fast, high resolution, x10 smaller low-energy tail
- Mu3e style silicon trackers – event reconstruction at high rates
- Pixelated target, customized for LFUV or PiBeta (separate) runs



\*Group just now forming; Please contact us ([hertzog@uw.edu](mailto:hertzog@uw.edu)) or others on LOI signatory list. 22 Institutes, (27 experimentalist; 5 theorists).

Thank you for your town hall contribution.

The next speaker is Sebastian Ellis

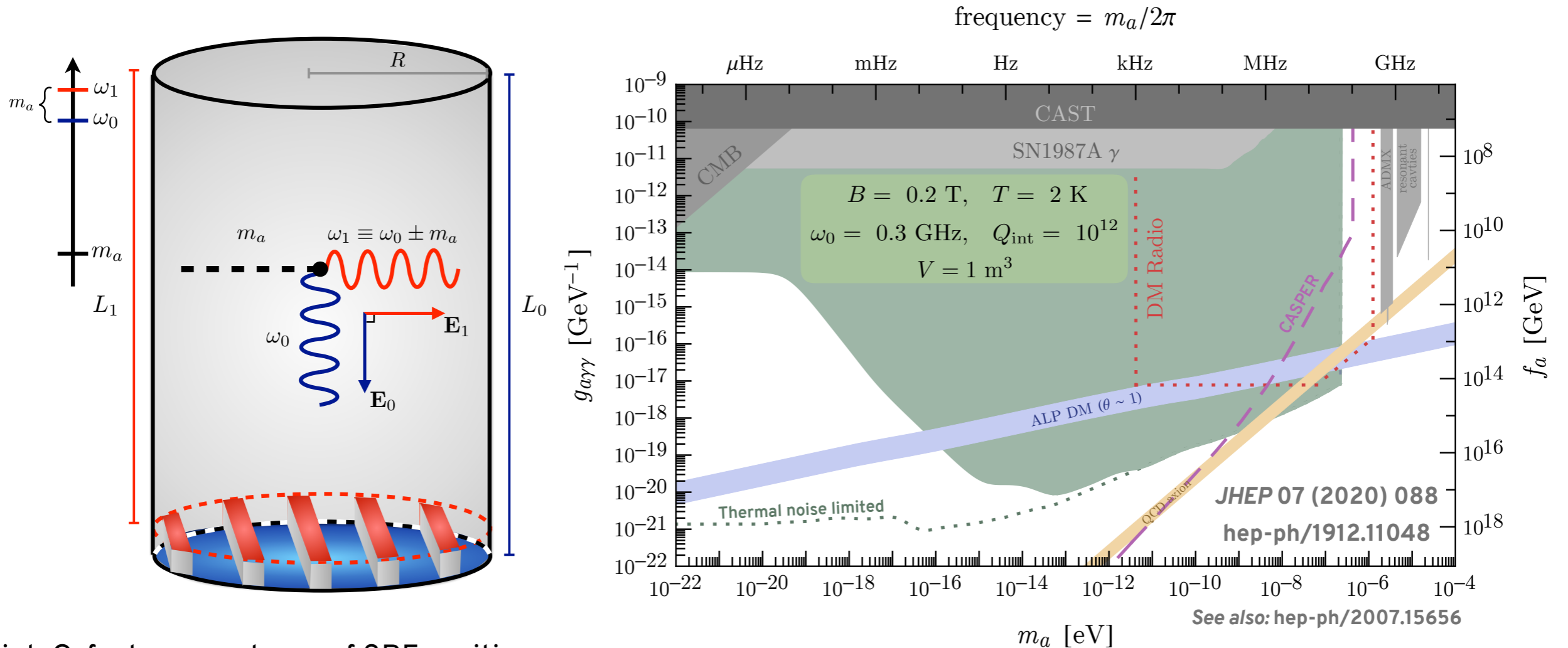
*Heterodyne Detection of Axion Dark Matter via  
Superconducting Cavities*

# HETERODYNE DETECTION OF AXION DARK MATTER VIA SUPERCONDUCTING CAVITIES

A. Berlin, R. T. D'Agnolo, SARE, C. Nantista, J. Neilson, P. Schuster, S. Tantawi, N. Toro, K. Zhou

Thematic Areas: (CF2) Dark Matter: Wavelike, (AF5) Accelerators for PBC and Rare Processes

Up-conversion of oscillating background B-field by axion DM to signal cavity mode



- High Q-factor, cryo temp of SRF cavities
- Signal matched to cavity resonance by deformations of walls
- Noise estimates derived from MAGO prototype & DarkSRF
- MAGO mode isolation  $\sim 140$  dB, DarkSRF wall control  $\sim 1/10^{10}$
- R&D required: cavity design, control, loading & readout

Thermal-limited reach enhanced compared with LC resonators: signal and exp. volume matched

$$\frac{\text{SNR}}{\text{SNR}^{\text{LC}}} \sim \frac{\omega_0}{m_a} \left( \frac{Q_{\text{int}}}{Q_{\text{LC}}} \right)^{1/2} \left( \frac{T_{\text{LC}}}{T} \right)^{1/2} \left( \frac{B_0}{B_{\text{LC}}} \right)^2$$

$\mathcal{O}(1)$

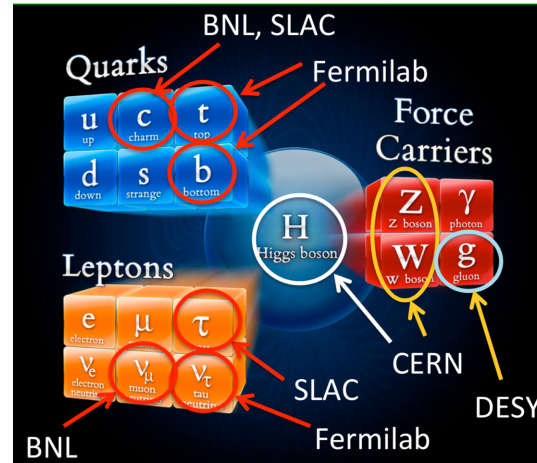
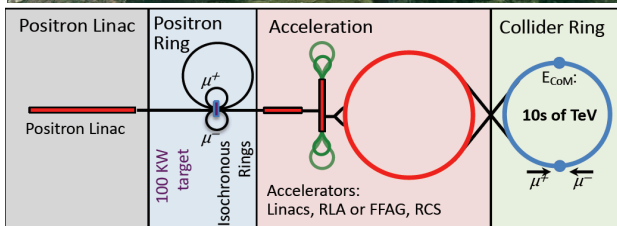
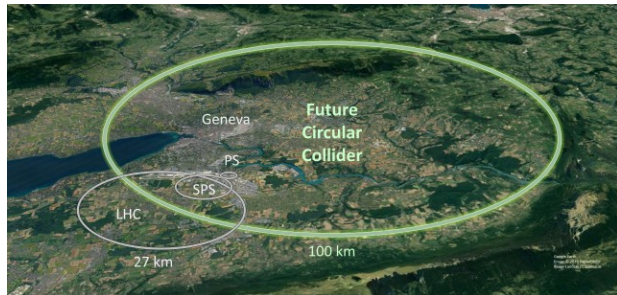
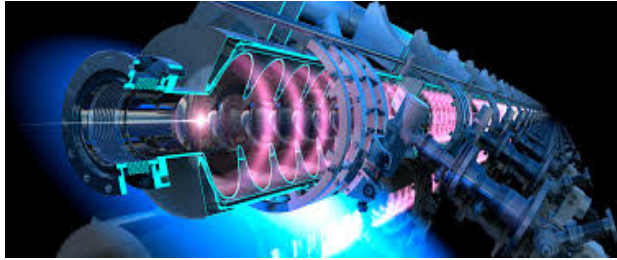
Thank you for your town hall contribution.

The next speaker is Marcela Carena

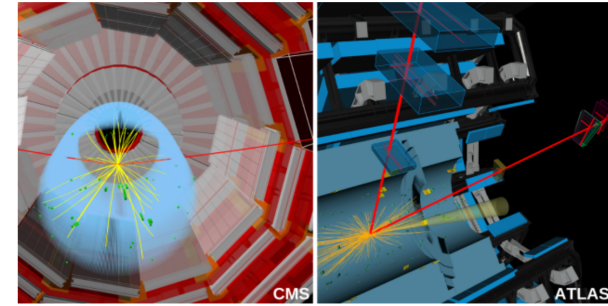
*Towards Future Discoveries at the Energy Frontier*

# Towards Future Discoveries at the Energy Frontier

Marcela Carena  
Fermilab and U. Chicago



What is next?



Higgs boson decaying into two muons



Thank you for your town hall contribution.

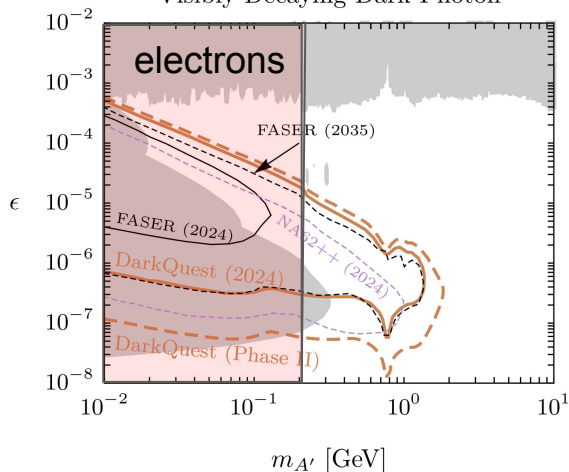
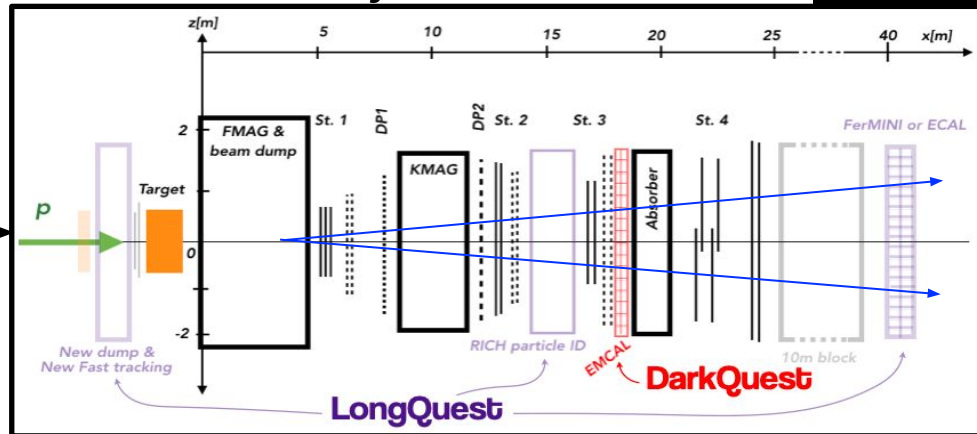
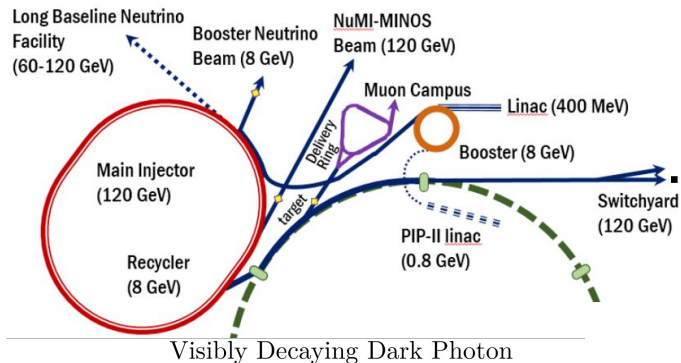
The next speaker is Philip Harris

*DarkQuest and LongQuest at the 120~GeV Fermilab  
Main Injector*

# DarkQuest/LongQuest: The Idea



## - Dark Sector Search at Fermilab Main Injector



- An upgrade of the existing SpinQuest experiment
  - Added EMCAL to search displaced electrons
- Experiment to run 120 GeV proton beam in 2023
- Capable of searching for displaced objects
  - New Powerful constraints on Dark Sector
- LongQuest: Further upgrade for displaced searches

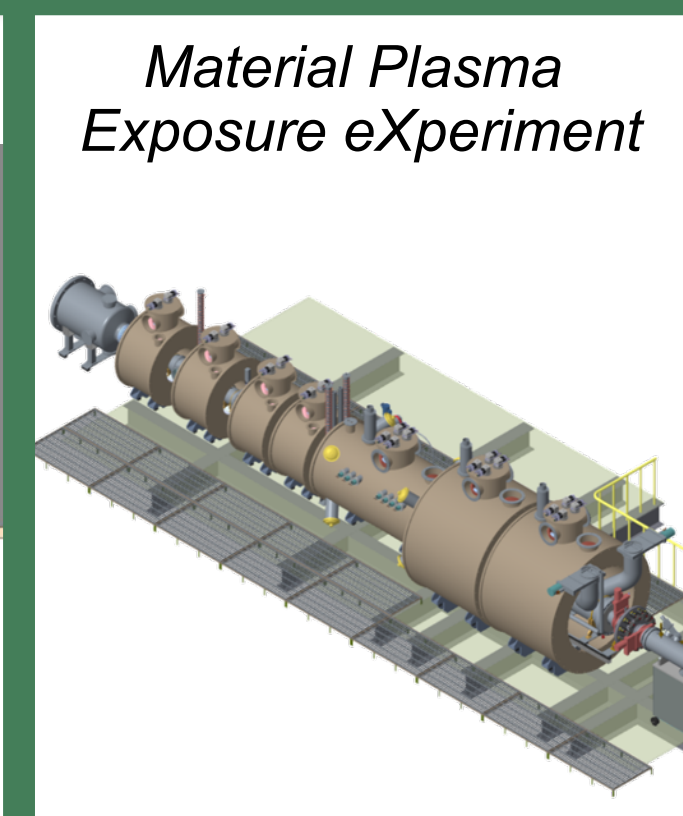
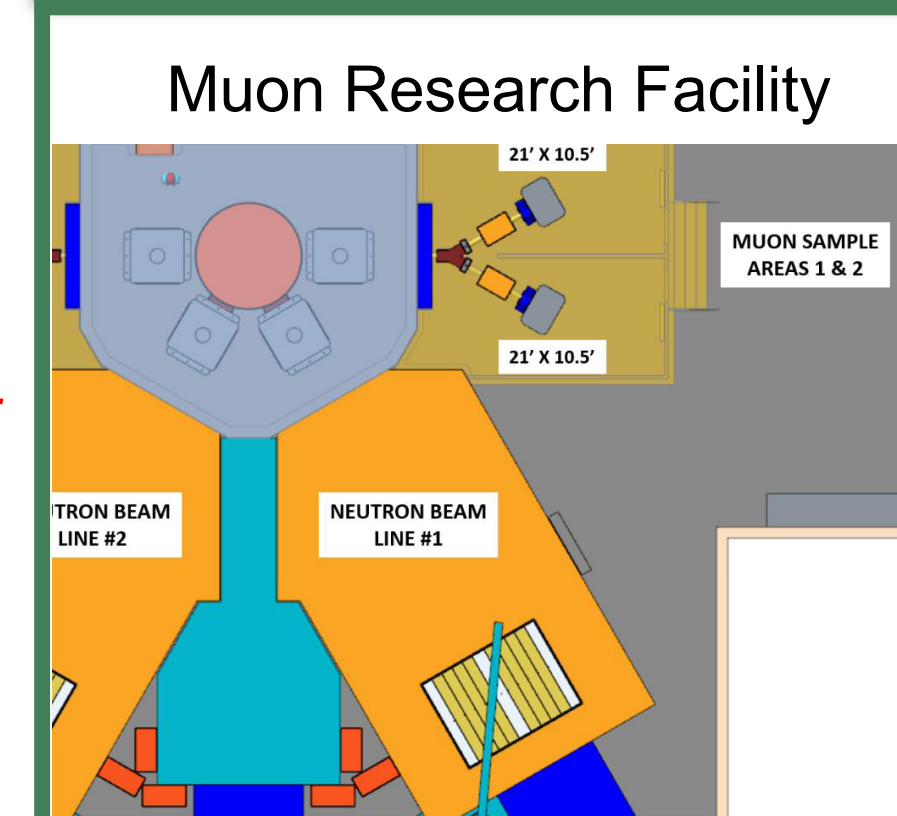
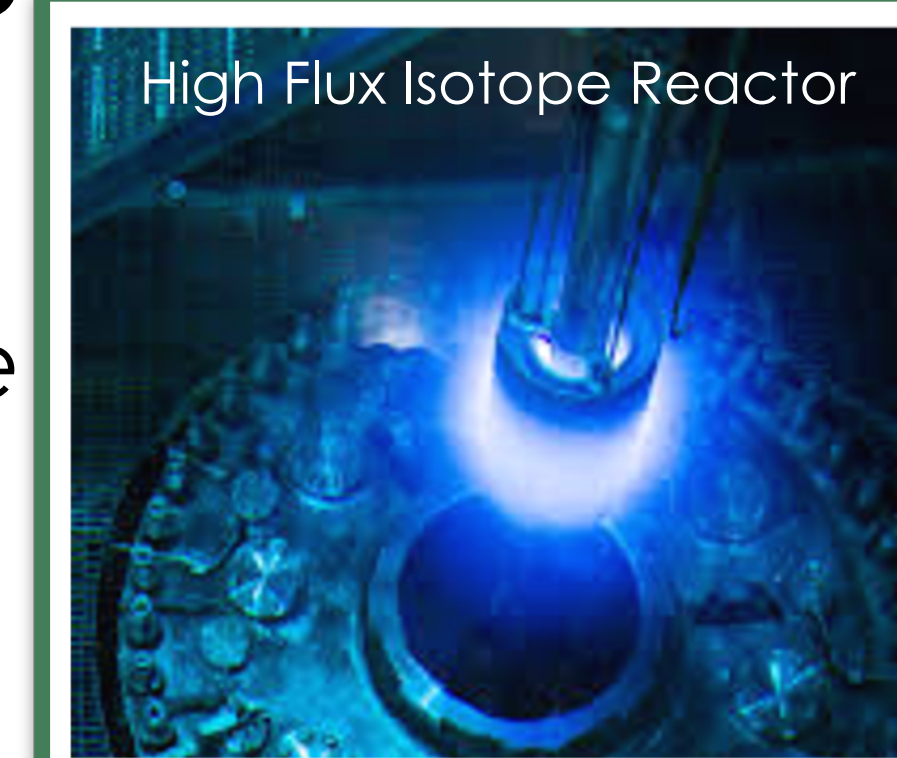
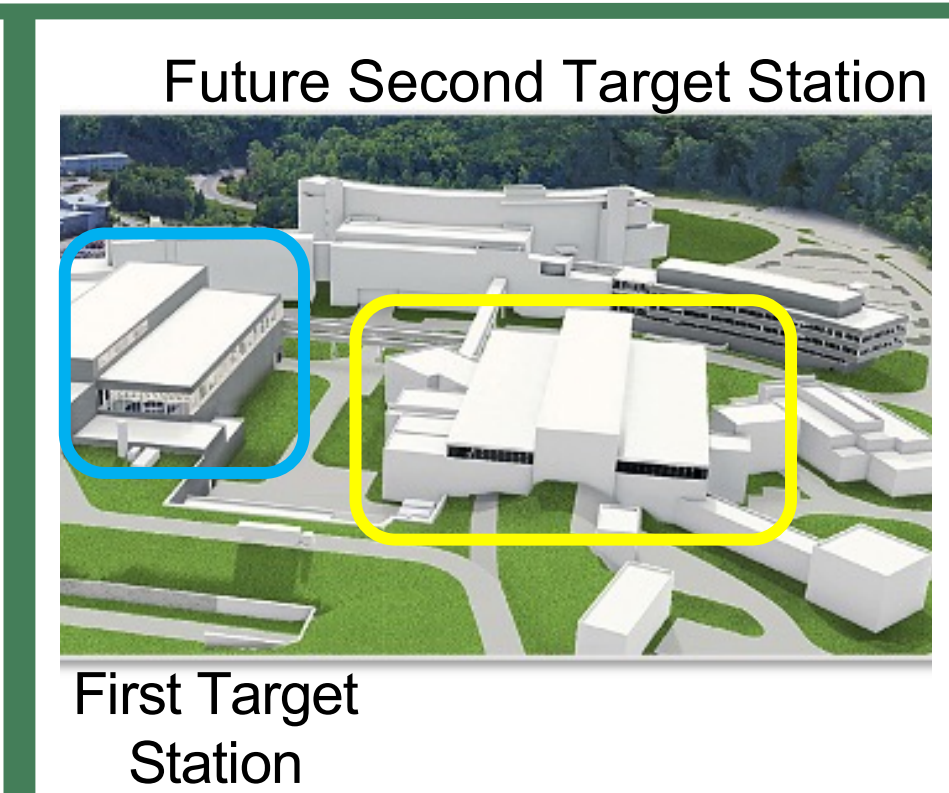
Thank you for your town hall contribution.

The next speaker is Marcel Demarteau

*Perspective on a Unified US Particle Physics  
Program*

# Invitation of ORNL to the HEP community

- The Spallation Neutron Source is the **brightest, background free, neutrino source** from pion decay at rest: discovered CEvNS in 2017.
- SNS is the leader in the high-power accelerator frontier: **2.8MW proton driver by 2025**; Second Target Station (~2030) will be a unique neutrino source.
- The High Flux Isotope Reactor (HFIR) provides a **continuous neutrino source** of single flavor from pure U-235 reactor fuel.
- Two upgrades of HFIR being considered to enable **dedicated fundamental physics laboratories** that could have a transformative impact on the field of fundamental physics.
- Using the SNS infrastructure a muon spin resonance and single event radiation research facility being considered:  **$1.9 \times 10^8 \mu^+/\text{s}$**
- The Material Plasma Exposure eXperiment (MPEX) facility will measure materials up to **50 DPA, ion flux  $10^{24}$ - $10^{25} \text{ m}^{-2}\text{s}^{-1}$ , 40MW/m<sup>2</sup>**
- ORNL provides great opportunities to create a healthy and vibrant HEP program through a balance of small and large projects.  
**Together we are stronger !**



Thank you for your town hall contribution.

The next speaker is Brian Nord

*Culture change is necessary, and it requires strategic  
planning*

# *To create just research environments, culture change is necessary, and it requires planning*

*Change - Now* (also see related items: [snowmass LOI](#) and the [Change - Now call for action](#))

Problem: Racism permeates society, including the HEP community.

Evidence: a) The underrepresentation (and minoritization) of specific groups and b) extant behaviors and policies that disenfranchise people.

## Recommendations

1. **Familiarize** oneself with the problem space before implementing solutions;
2. Use **strategic planning** and re-envision the science workplace;
3. Engage in **community organizing** and shared leadership;
4. **Partner** with experts in appropriate disciplines;
5. Promote **constructive conflict** to confront core issues;
6. **Imagine.**

## A New Project

When we plan a project, we first establish clear and measurable goals. Then, we write down requirements. Then, we *grind* --- while working with experts and periodically reassessing the strategy --- until the requirements are met and the goal is accomplished.

You've imagined a future in which we understand nature in a new way.

*Now, imagine a future with justice.*

Thank you for your town hall contribution.

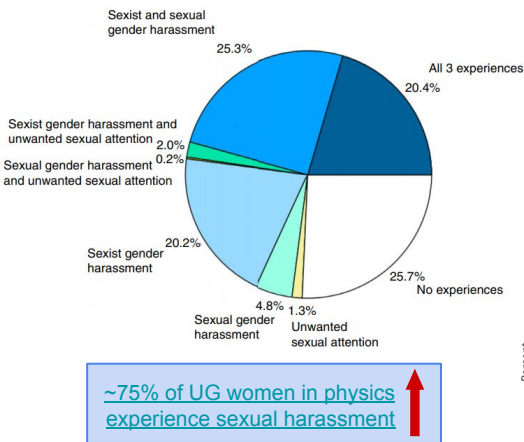
The next speaker is Kelly Stifter

*Snowmass as a path towards cultural change, and  
the role of collaborations*

# Snowmass as a path towards cultural change, and the role of collaborations

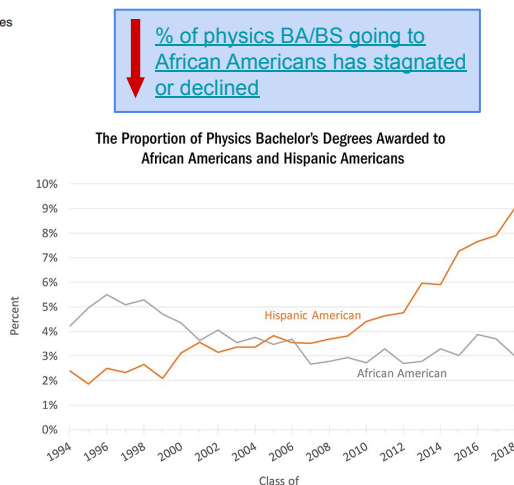
Authors: Micah Buuck (SLAC), Kirsty Duffy (Fermilab), Alvine Kamaha (University at Albany), Hugh Lippincott (UCSB), Rachel Mannino (University of Wisconsin), Mark Messier (Indiana University), Kim Palladino (University of Wisconsin, Oxford), Sally Shaw (UCSB), Erica Smith (Indiana University), Kelly Stifter (Stanford)

**Physics has historically not been an equitable field for many underrepresented groups:**



Progress will require:

1. Collaborations actively working towards establishing equitable cultures
2. Community working together to include actionable plan for lasting culture change in P5 report that supports collaborations



Must draw from expert reports and community calls: [AIP TEAM-UP Report](#), [NASEM Sexual Harassment report](#), [LGBT+ Inclusivity Report](#), [ChangeNow](#), [APS-IDEA](#)

Contributing LOIs: [Creating Inclusive Collaborations](#), [Community Support for Enforcing Collaboration Codes of Conduct](#)

Thank you for your town hall contribution.

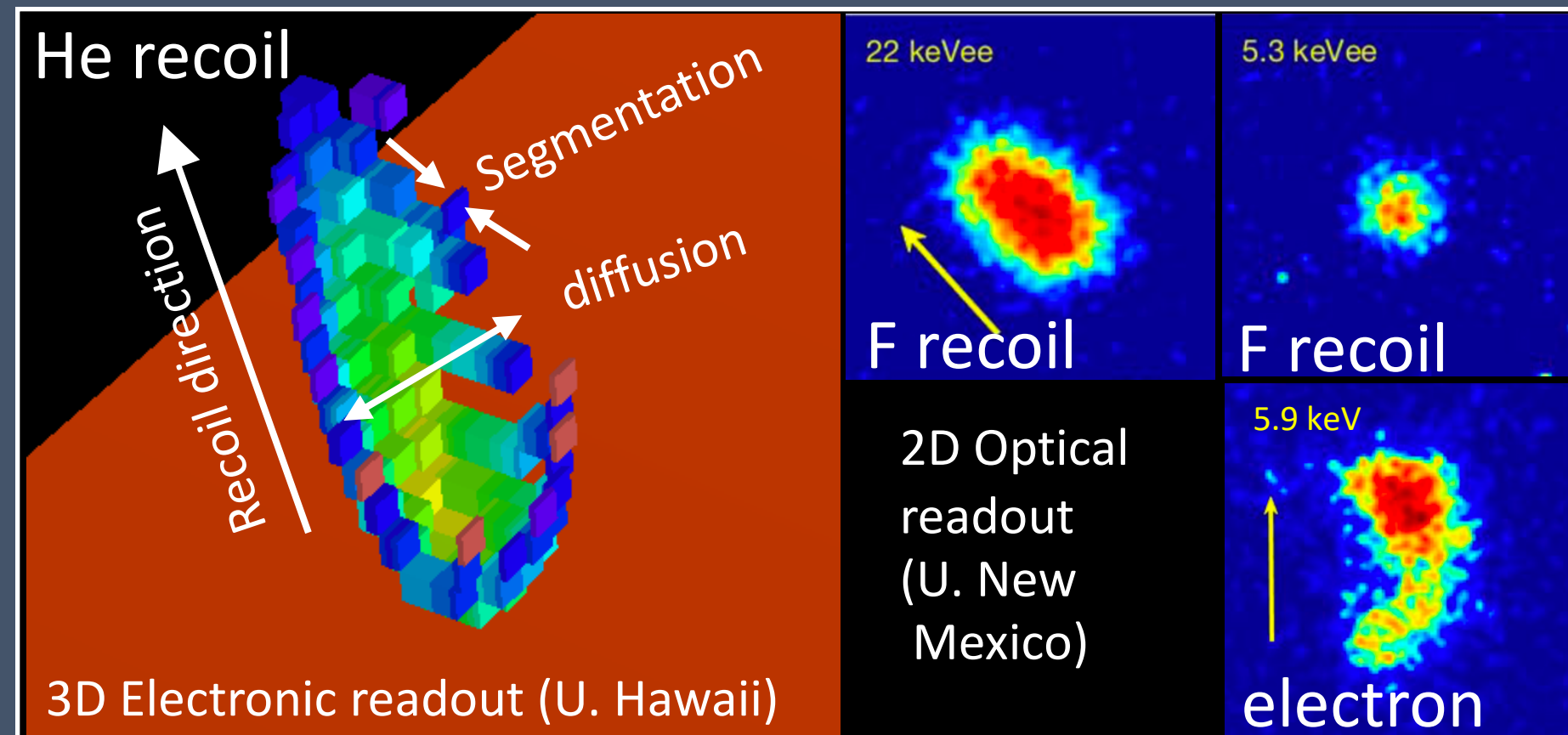
The next speaker is Sven Vahsen

*Gas TPCs with directional sensitivity to dark matter,  
neutrinos, and BSM physics*

# CYGNUS

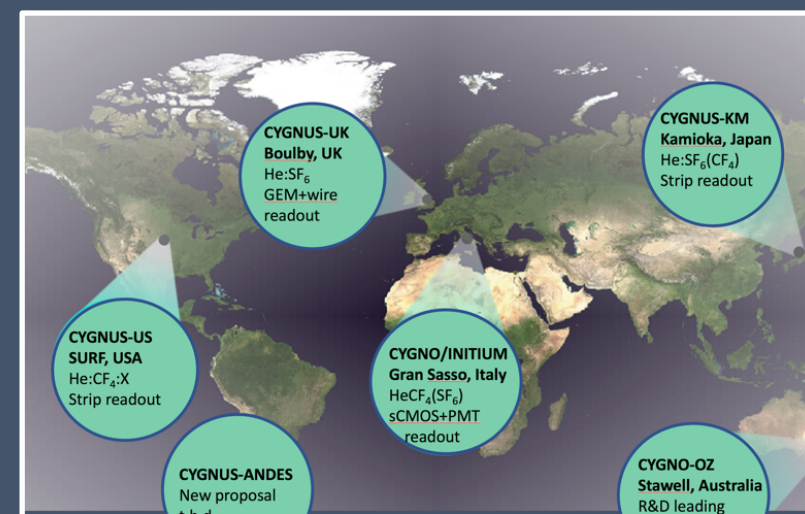
## Directional nuclear recoil detectors for neutrinos, dark matter, and BSM physics

- Gas TPCs with charge readout via MPGDs have enabled **directional detection of nuclear recoils and electrons**



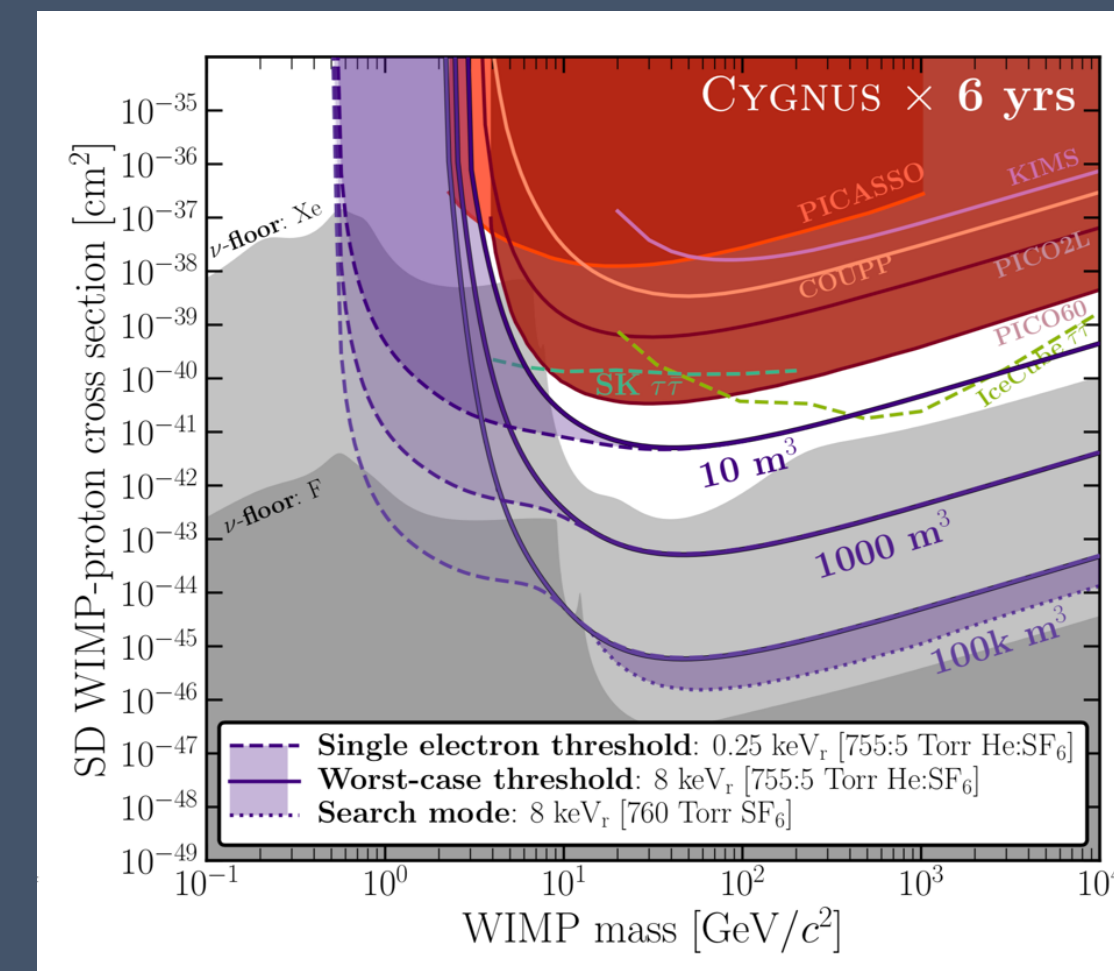
- Electron ID for  $< 10$  keVee, 3d fiducialization
- Directionality provides DM / neutrino discrimination**
- Long term vision: multi-site observatory

- Sufficient exposure to penetrate neutrino floor
- Maximize directionality via negative ion gas mixture with Helium
- $P=1$  atm,  $T=300$  K (!)



- International proto-collaboration formed**
- Growing support: funded efforts in EU/Italy/Australia

- Opportunity for long-term program: new physics opportunities for each factor 10 increase in exposure**
- Strawman* design paper: [arXiv:2008.12587](https://arxiv.org/abs/2008.12587), focused on DM and neutrinos



- Exposure, size ↓
- Migdal Effect measurement
  - Coherent Elastic Neutrino-Nucleus Scattering (CEvNS) at either NuMI or DUNE
  - Competitive DM limits in SI and SD
  - CEvNS from solar neutrinos
  - Efficiently penetrating the  $\nu$  floor
  - Observing galactic DM dipole
  - Measuring DM particle properties and physics
  - Geoneutrinos
  - WIMP astronomy

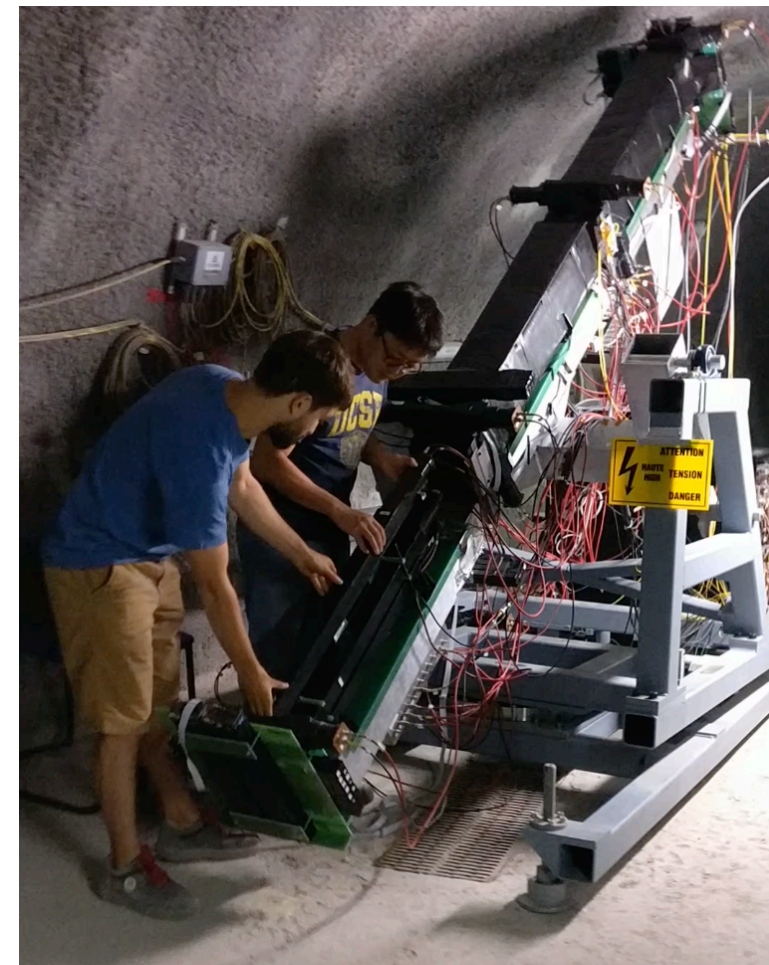
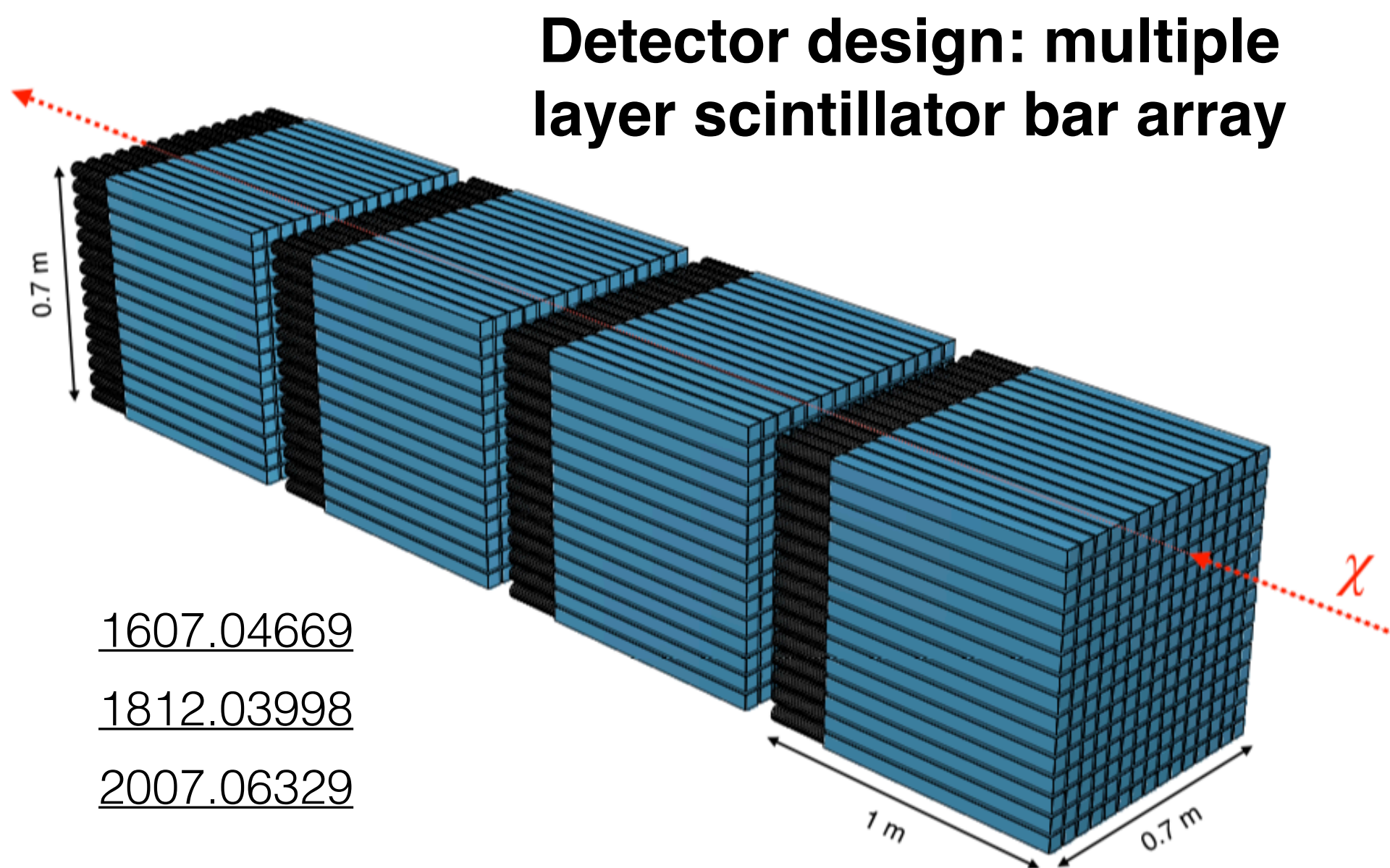
- Many new proposals in HEP community that should be explored
  - New mediators in CEvNS, Low-mass DM, Up-scattered heavy neutrinos and DM, Axion like particles**
- New ideas could still have major impact
- Relevant to Cosmic, Neutrino, and Instrumentation Frontiers
- Planning inter-frontier Snowmass CYGNUS Mini-workshop**
  - brainstorm and seed white paper effort

Thank you for your town hall contribution.

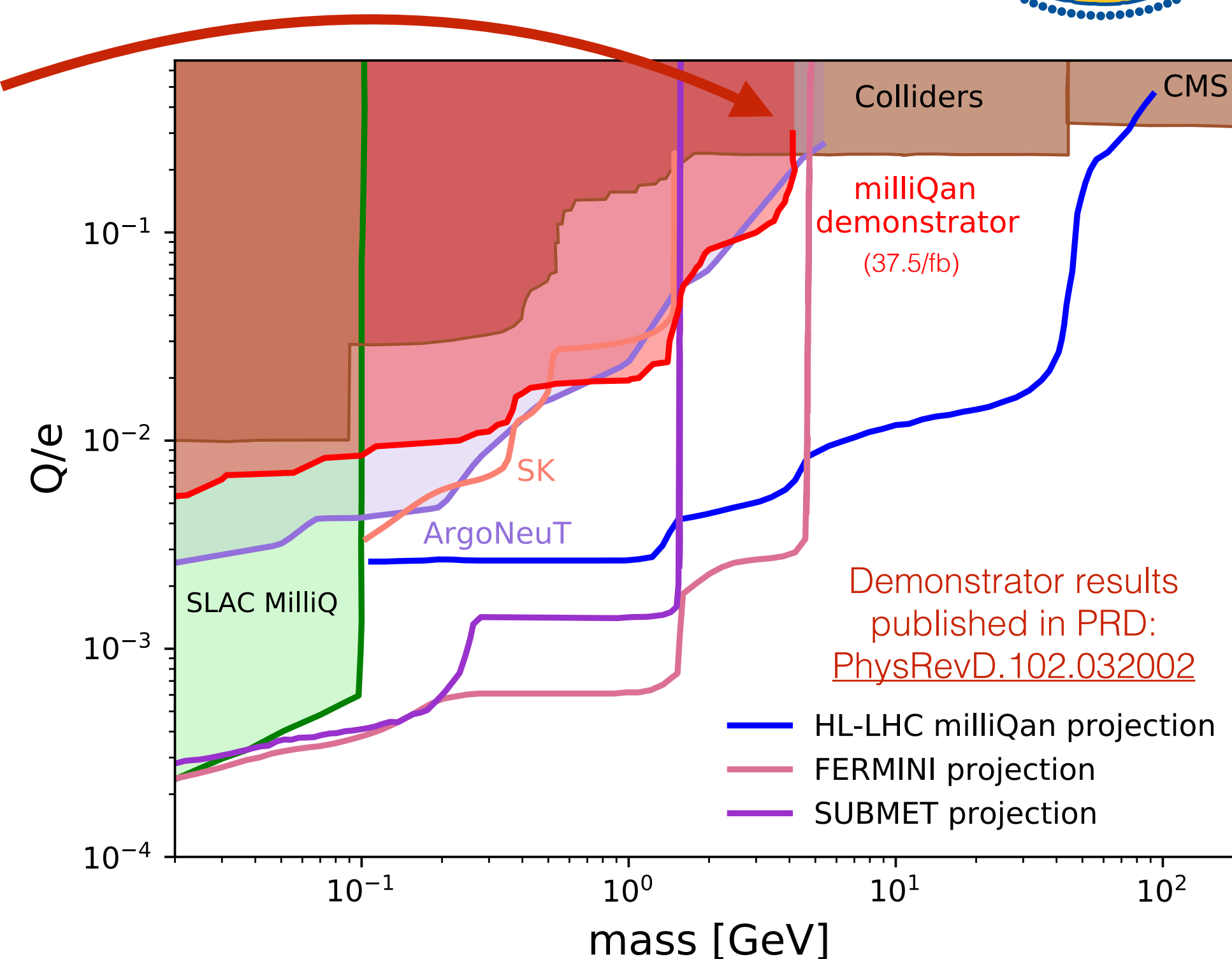
The next speaker is Matthew Citron

*Searching for millicharged particles with scintillator  
based detectors*

# Searching for millicharged particles with scintillator-based detectors



## Small scintillator-based prototype detector at the LHC



## Proposed detectors:

**milliQan** at the **LHC** with sensitivity for  $m < \sim 45$  GeV

**SUBMET** at **J-PARC** with sensitivity for  $m < \sim 1.5$  GeV

**Fermini** at **Fermilab** with sensitivity for  $m < \sim 5$  GeV

+ possible detector at proposed **FPF**

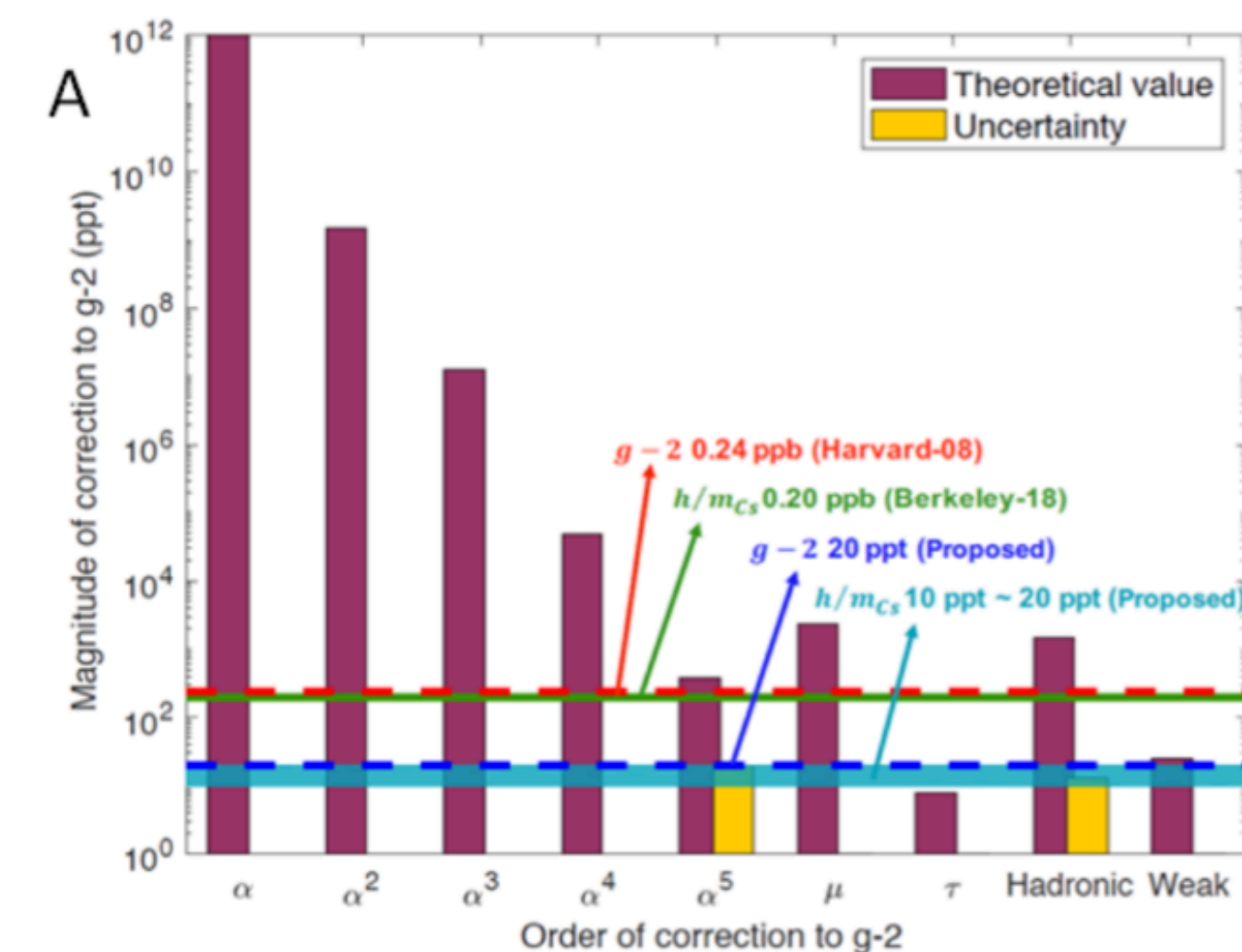
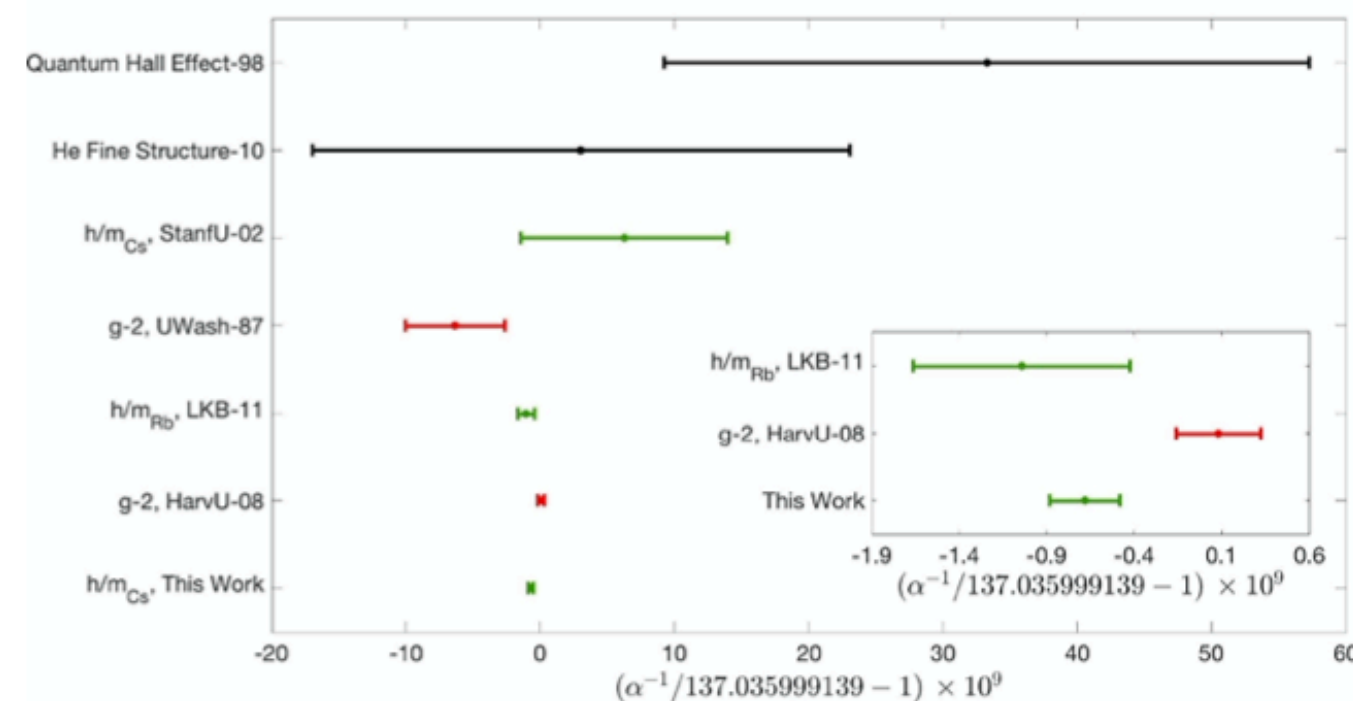
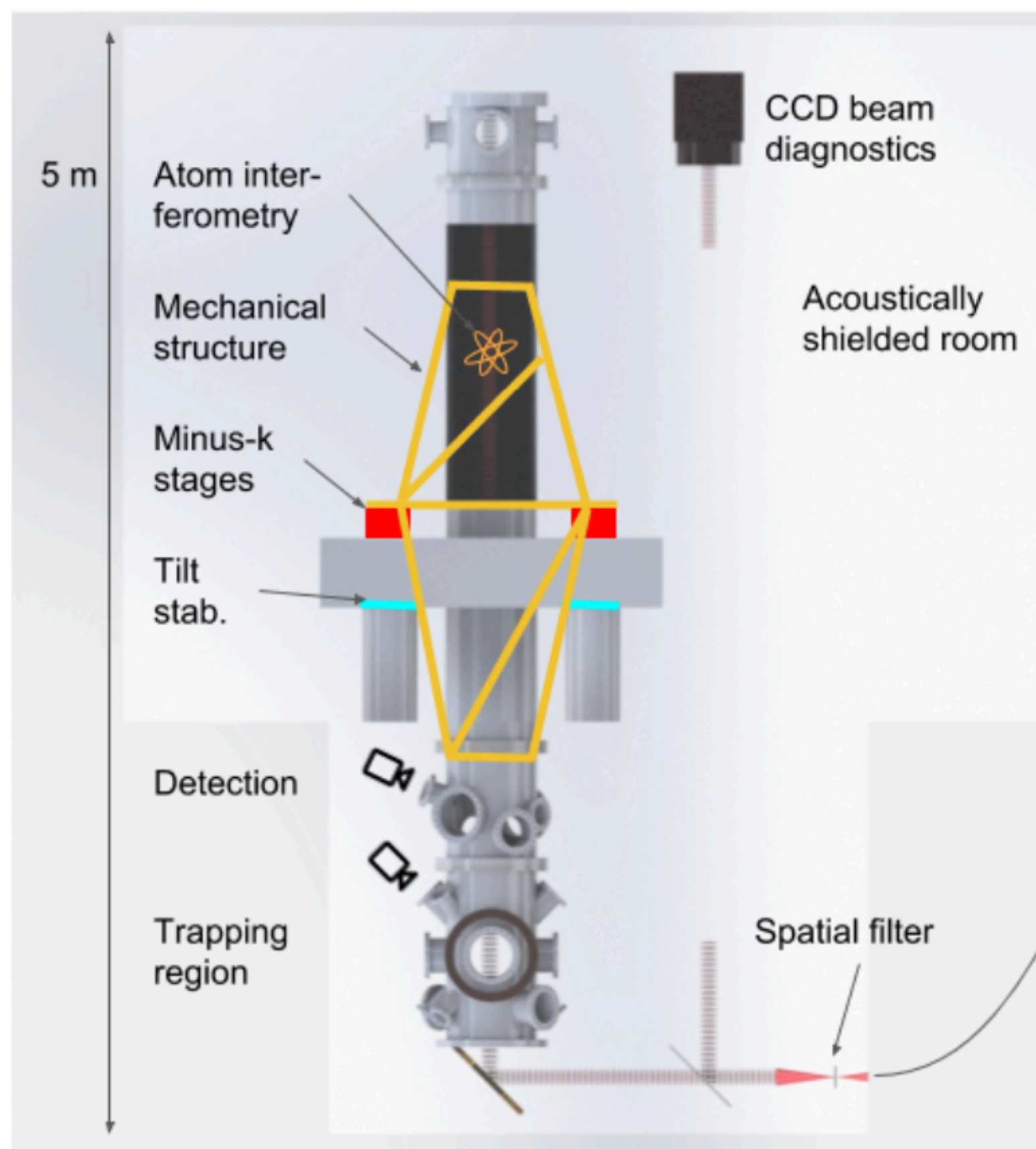
LOI: use data from the successful milliQan prototype to update these projections with **full consideration of backgrounds** and **realistic performance** as well as propose **fundamental improvements** to the detector

Matthew Citron [mcitron@ucsb.edu](mailto:mcitron@ucsb.edu)

Thank you for your town hall contribution.

The next speaker is Holger Mueller

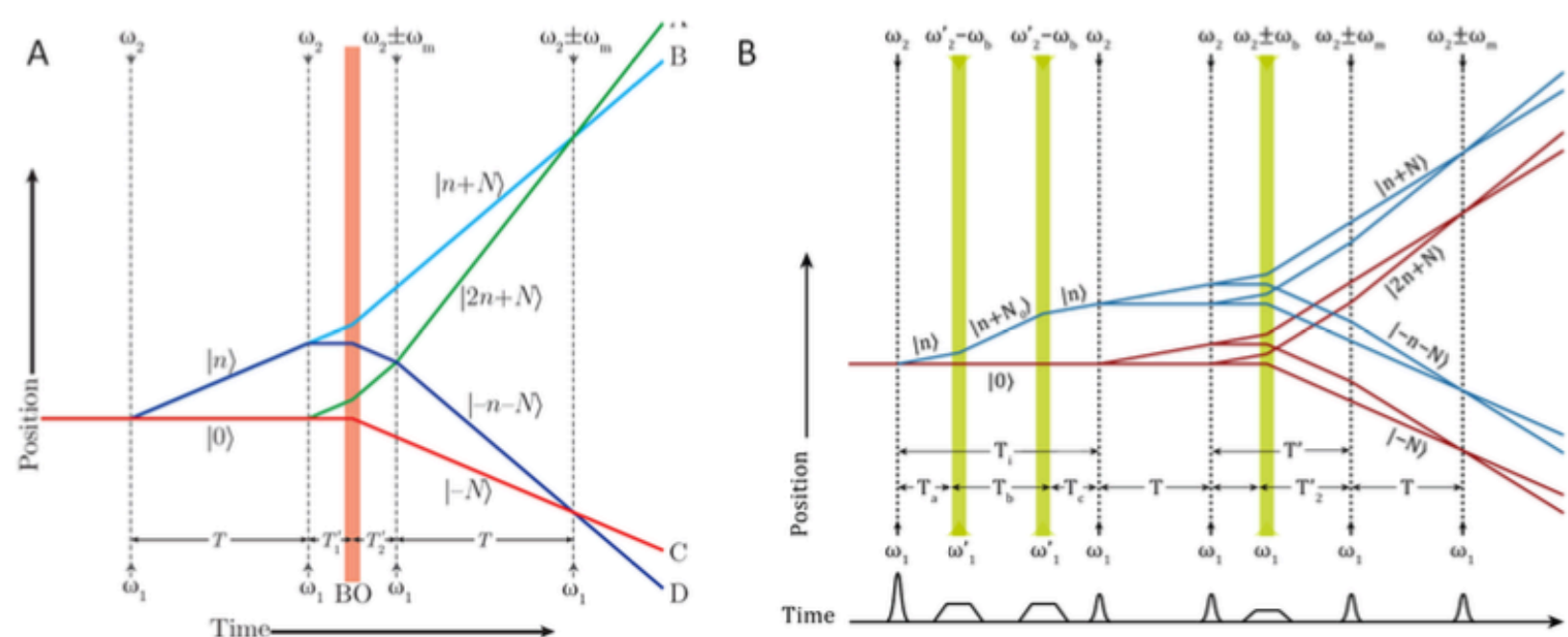
*Alpha: Measurement of the fine structure constant as  
test of the Standard Model*



## Search for Beyond the Standard Model Physics by Measuring the Fine-Structure Constant

David Brown, LBNL; Holger Mueller, LBNL and UC Berkeley

- Improve  $\alpha$  to 10-20 ppt from 200 ppt
- Broad and deep test of the Standard Model,
- Broad and sensitive search for dark-matter candidates



Thank you for your town hall contribution.

The next speaker is Harvey Newman

*Future Information and Communications*

*Technologies for HL-LHC Era: Beyond CMOS and*

*Beyond the Shannon Limit*

# Future ICT: Revolutions and HEP Vision for 2028 and Beyond

H. Newman



- We will confront several technology barriers from now to ~2028
  - Processors: 10 nm and 7 nm feature size designs difficult [Intel delay]; where is the limit in practice: 5nm ? 3 nm ? 2 nm ?
  - Magnetic storage: Below ~10nm “superparamagnetic limit”
  - Communications: the non-linear Shannon limit, and energy/heat limits
- By ~2028 and beyond we will need to avoid the speed/energy tradeoffs of classical electronic systems to sustain our progress and our economy
- Fortunately: plans and R&D for the transition are already underway [but HEP is so far relatively unaware]
  - Nanophotonics, plasmonics, and/or spintronics: ultrafast low energy signaling
  - Beyond CMOS: memory, logic devices, integrated electronic/photonics systems ([ieee.irds.org](http://ieee.irds.org))
  - Metamaterials and devices: To shape and direct light, form wavefronts and beams; also *programmably*
  - Beyond Shannon long haul optical communications systems and methods: SDM, 6G Wireless
- These [R]evolutions will affect more than computing: TriDAS, all comms, intelligent “coherent” systems; our working + home environments
- There will be great design and physics opportunities at the HL-LHC in 2030-38, and beyond for future experiments and accelerators
- Bottom Line: We will need to follow, join and lead some of these forefront developments, as part of our future experimental roadmap and “frontiers”

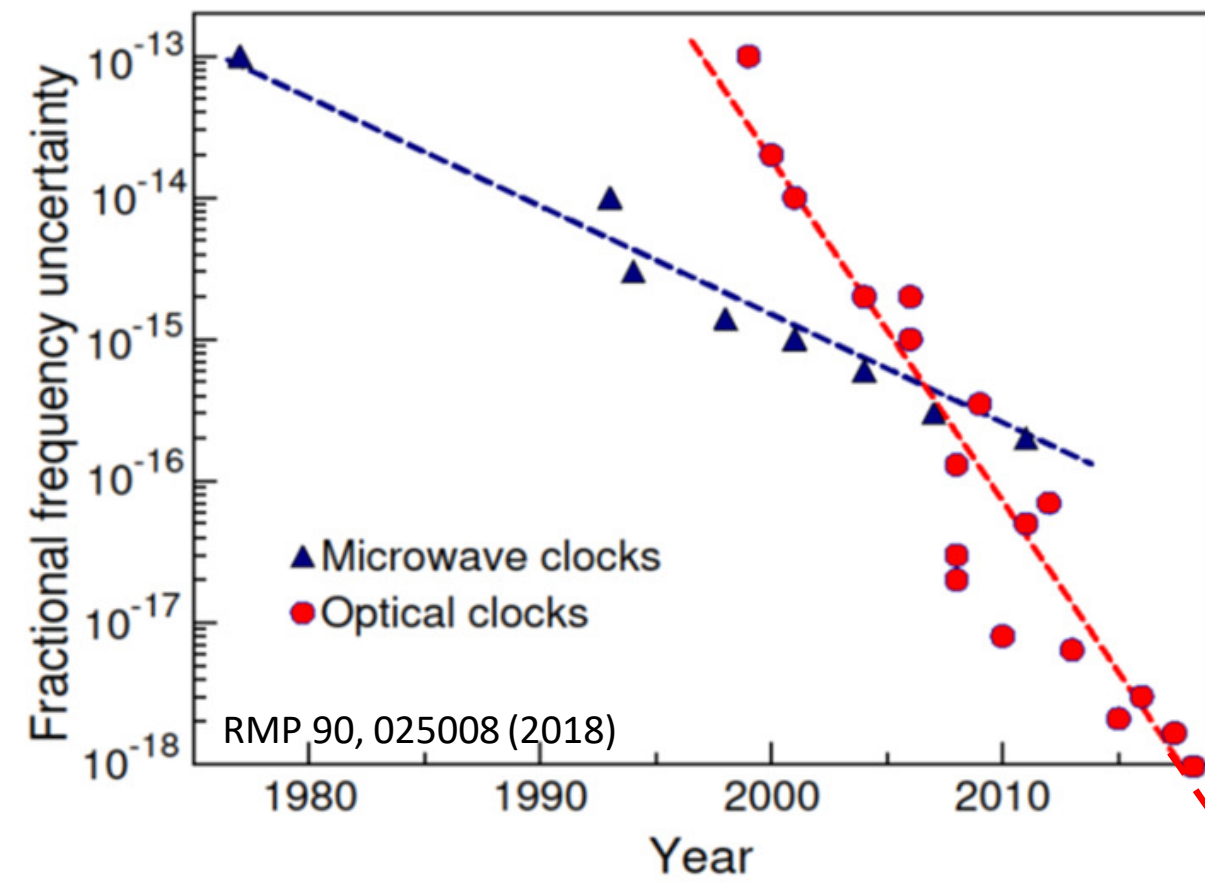
- More Information: [https://www.dropbox.com/s/fkwfrtdlx4lwhop/FutureICTfor%20theHLLHC\\_2030andBeyond\\_V4hbn081020.pptx?dl=0](https://www.dropbox.com/s/fkwfrtdlx4lwhop/FutureICTfor%20theHLLHC_2030andBeyond_V4hbn081020.pptx?dl=0)

Thank you for your town hall contribution.

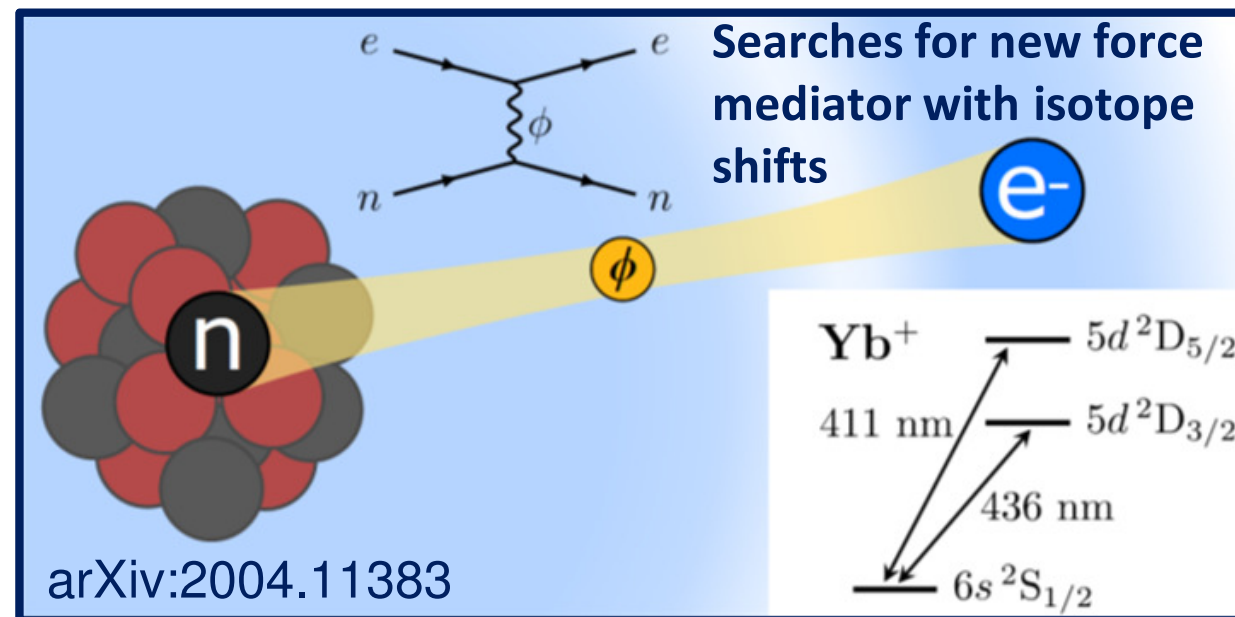
The next speaker is Marianna Safronova

*Atomic/nuclear clocks and precision spectroscopy  
measurements for dark matter and dark sector  
searches*

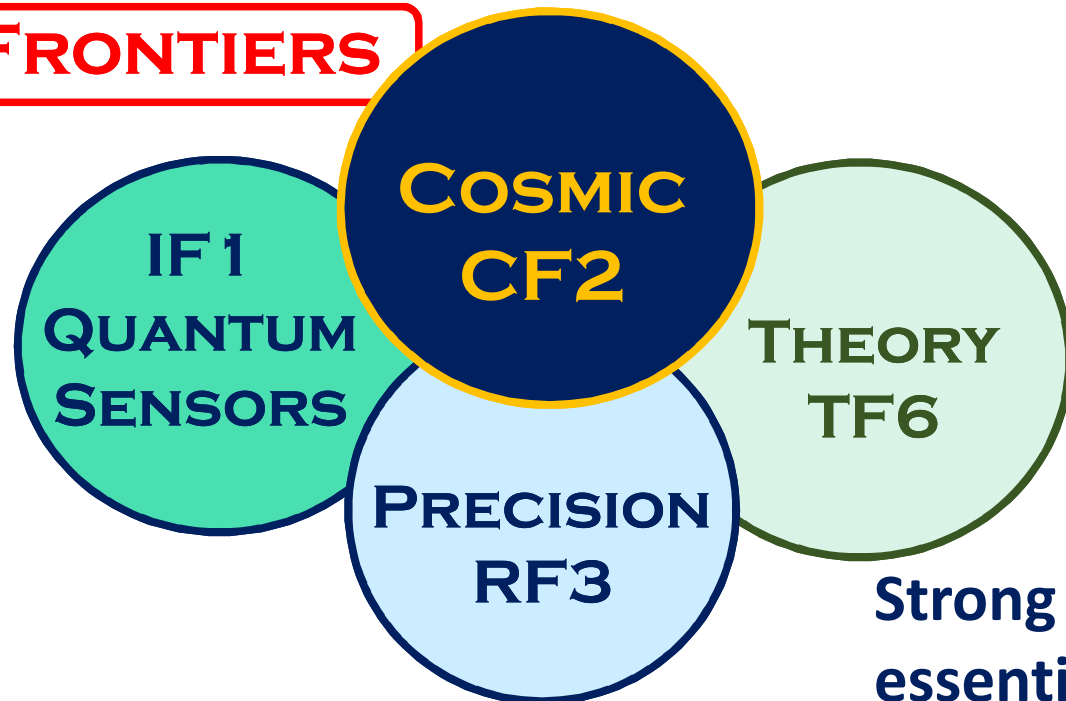
# ATOMIC/NUCLEAR CLOCKS AND PRECISION SPECTROSCOPY MEASUREMENTS FOR DARK MATTER AND DARK SECTOR SEARCHES



**Extraordinary improvement of precision of optical atomic clocks  
1 second loss per 30 billion years!**



**FRONTIERS**



Presenter: Marianna Safronova (University of Delaware) msafrono@udel.edu

Collaboration: Australia, Austria, Germany, Israel, Japan, Russia, S. Korea, USA

Co-authors: J. C. Berengut, S. Brewer, D. Budker, J. R. Crespo López-Urrutia, A. Derevianko, V. V. Flambaum, E. Fuchs, R. Harnik, E. R. Hudson, A. M. Jayich, S. Kolkowitz, M. G. Kozlov, G. Lee, D. R. Leibbrandt, R. Ozeri, A. Pálffy, G. Paz, E. Peik, G. Perez, P. O. Schmidt, T. Schumm, V. M. Shabaev, Y. Soreq, Y. Stadnik, A. Surzhykov, P. G. Thirolf, V. Vuletić, J. Ye, V. A. Yerokhin, J. Zupan

**Are fundamental constants constant?**

Ultralight dark matter can cause variation of fundamental constants

$$\alpha \propto \frac{m_e}{m_p} \frac{m_q}{\Lambda_{QCD}}$$

A number of beyond the SM theories proposed to solve various problems of the SM, such as the gauge hierarchy, the strong CP problem or the flavor puzzle, feature light new particles with masses well below the GeV scale and small couplings to the matter fields.

This project **presents a broad range of different experiments** with atomic and nuclear clocks and other precision spectroscopy techniques to search for bosonic light dark matter and new force carriers. Develop new highly-charge ion and nuclear clocks & clock networks.

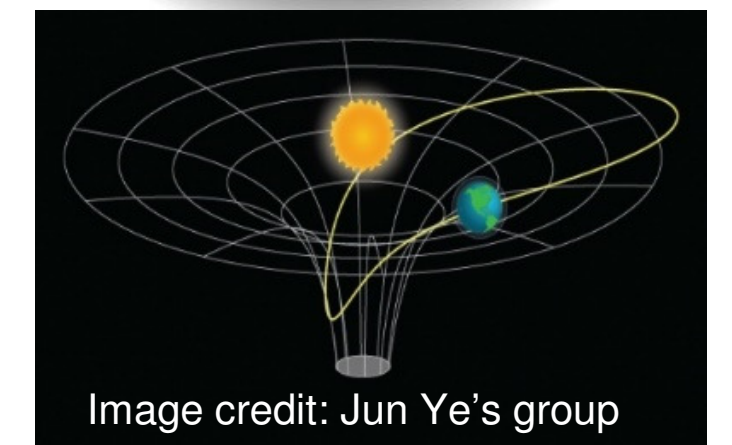
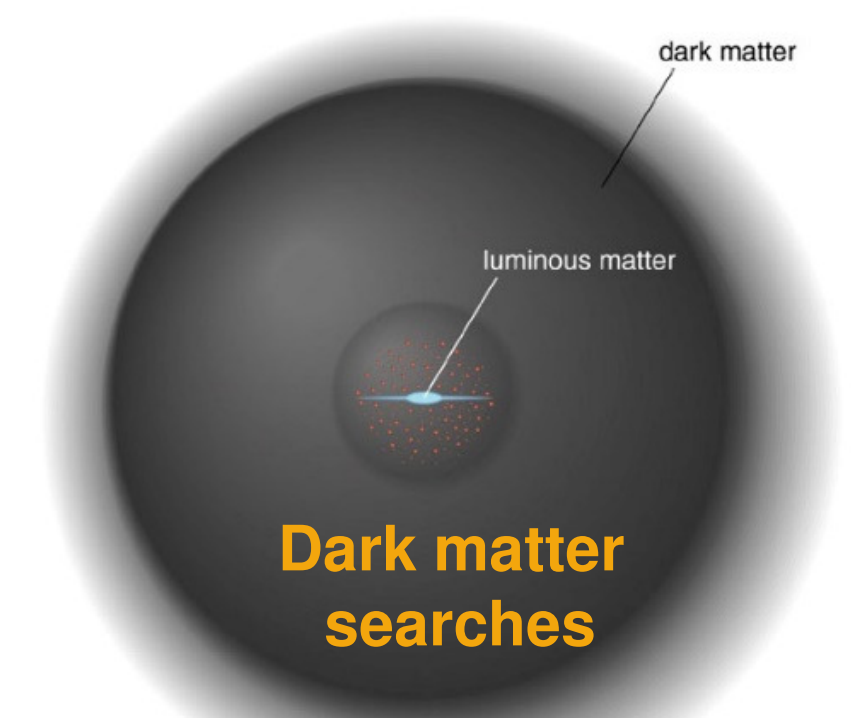
**Goal: improve sensitivity by at least 7 or more orders of magnitude (in coupling strength to SM) for broad range of DM masses.**

This project is a part of a rapidly developing field of precision atomic and molecular searches for physics beyond the standard model. **~30 Lol submitted.** Recent review: Search for new physics with atoms and molecules, Safronova et al., Rev. Mod. Phys. 90, 025008 (2018).

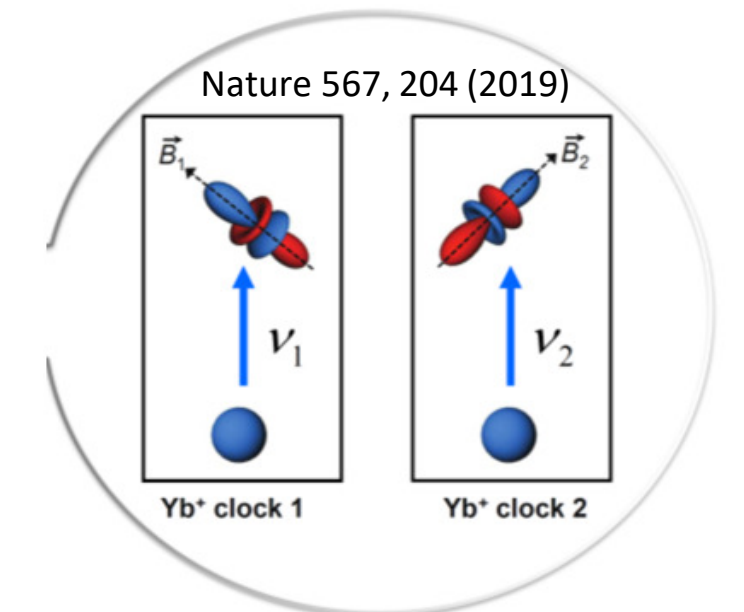
**Snowmass process goal: further develop collaborations with particle physics**

**We hope to stimulate in the community broad interest in new possibilities of precision AMO searches for physics beyond the standard model.**

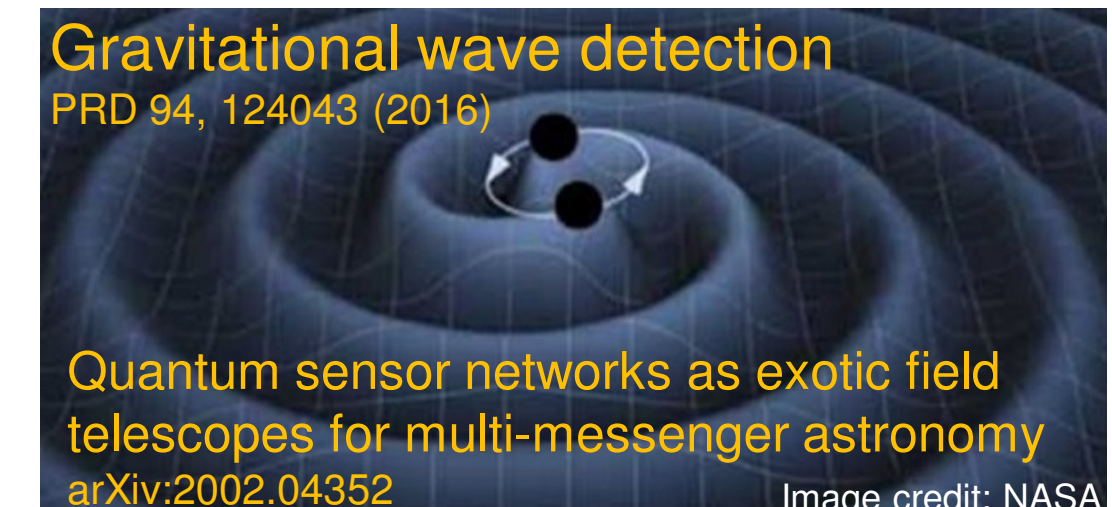
Strong collaboration of atomic, molecular, and optical (AMO) physics and particle physics communities is essential for full realization of new opportunities presented by new quantum technologies.



Tests of the equivalence principle



Search for the violation of Lorentz invariance



Thank you for your town hall contribution.

The next speaker is Francesco Giovanni Celiberto  
*3D proton tomography at the EIC: TMD gluon  
distributions*

# 3D proton tomography at the EIC: TMD gluon distributions

## Motivation

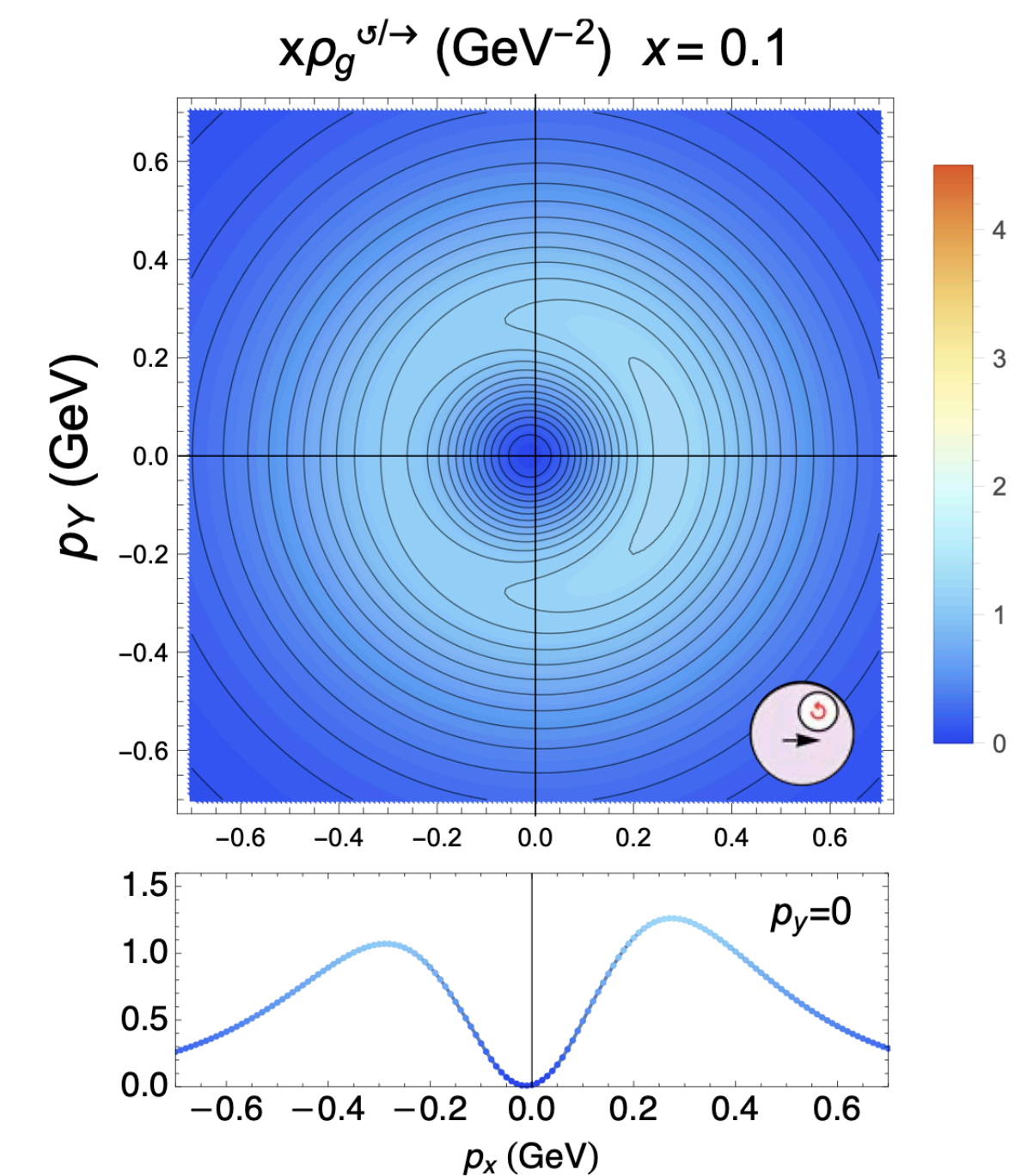
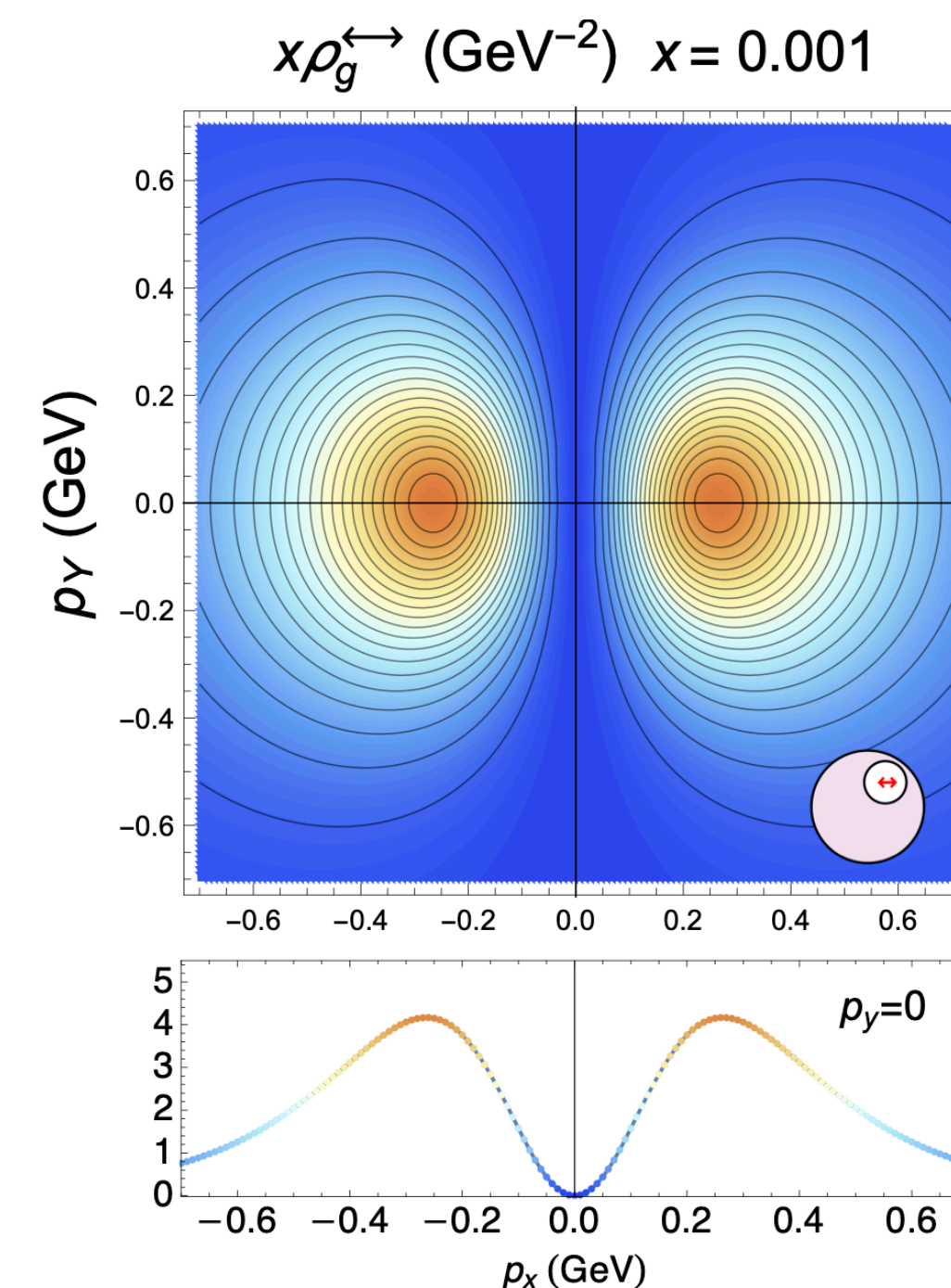
- \* Gluon TMD PDFs: *core* sector of **EIC** studies
- \* Need for a *flexible* model, suited to *pheno*
- \* **Unpolarized** and **polarized** distributions

## Status & prospects

- ☒ Twist-2 *T*-even gluon TMD PDFs
- ☒ Small- and moderate-*x* effects
- ☐ Twist-2 *T*-odd gluon TMD PDFs (**Sivers**, etc.)
- ☐ **Spin asyms: pseudodata & impact studies**
- ☐ Pheno support to small-*x* physics

## Francesco Giovanni Celiberto

**HAS QCD Group**, Università di Pavia & INFN



Thank you for your town hall contribution.

The next speaker is Richard Talman

*Colliding beam elastic pp and pd scattering to test T-  
and P-violation*

# Colliding beam elastic $pp$ and $pd$ scattering to test $T$ - and $P$ -violation

R. Talman<sup>1</sup> and N. N. Nikolaev<sup>2</sup>

<sup>1</sup>Laboratory for Elementary-Particle Physics, Cornell University, Ithaca NY, 14850, USA

<sup>2</sup>L.D. Landau Institute for Theoretical Physics, 142432 Chernogolovka, Russia

<sup>2</sup>Moscow Institute for Physics and Technology, 141700 Dolgoprudny, Russia

## 1 Goals

October 3, 2020

- Detect beyond Standard Model *semi-strong  $T$ -violation in elastic  $pp$  or  $pd$  scattering*; suggested by Lee & Wolfenstein, Prentki & Veltman, and Okun, to be a source of CP-violation. It still awaits the *experimentum crucis*
- Reduce elastic scattering  $pp$  and  $pd$  T-violating upper limits, currently a few percent, by more than an order of magnitude

## 2 Method

- Use highly polarized beams in a CPEDM-proposed “EDM prototype” storage ring (with superimposed electric and magnetic bending) for colliding beam (seemingly) elastic scattering measurement
- Measure below pion threshold elastic  $pp$  and  $pd$  scattering in (fixed-target-equivalent)  $150 < E < 400$  MeV range
- Use JEDI-Juelich-developed (F. Abusaif et al., arXiv:1812.08535, 2019) long spin coherence time, spin-phase-locked, pure-spin-state, polarized beams
- Final state detection is provided by stopping the scattered particles in azimuthally symmetric, polarization-sensitive tracking chambers, with acceptance totaling  $3\pi$  sr
- High-efficiency polarimetry is feasible only because both scattered particles can be detected and ranged out in the same large aperture polarimeter, making collider experiments superior to fixed target experiments
- Analyzing powers of final-state, single-particle polarizations are sensitive to  $T$ -violation in double-spin observables

## 3 Anticipated performance

- Luminosity of  $0.6 \text{ mb}^{-1}\text{s}^{-1}$  produces  $10^8$  clean elastic scatters per year

Thank you for your town hall contribution.

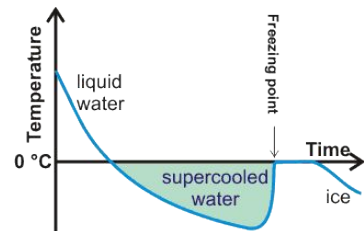
The next speaker is Matthew Szydagis

*Metastable Water: Breakthrough Technology for Dark  
Matter & Neutrinos*

# Metastable Water - A Breakthrough Tech for Dark Matter & Neutrinos

arXiv:1807.09253

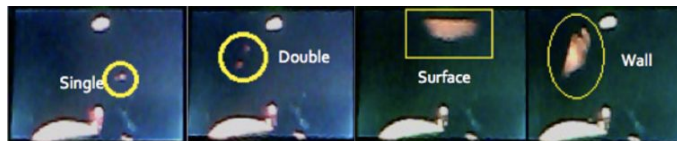
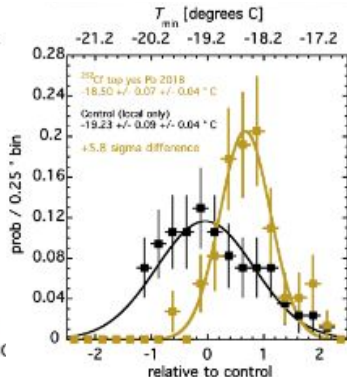
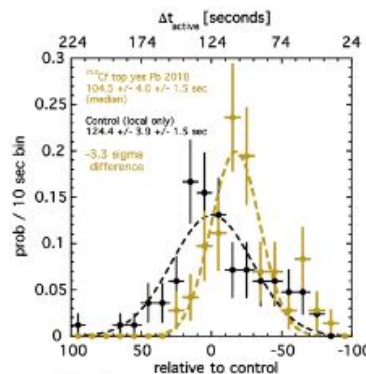
**Speaker:**  
**Matthew**  
**Szydagis**



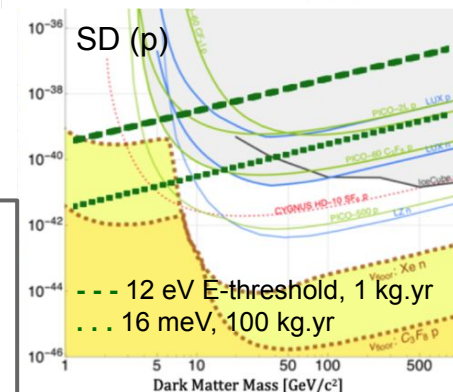
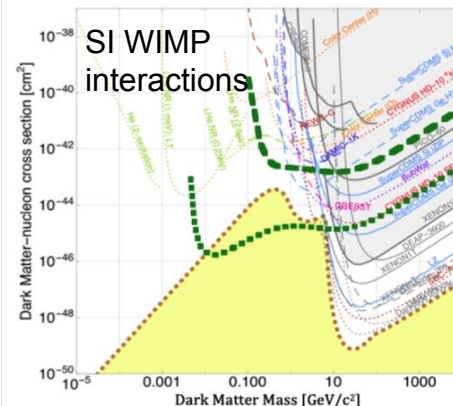
- Metastable, phase-transition detector
- Supercooled water
- The SNOWBALL CHAMBER
- Liquid to solid
- Ideal for low-mass DM
- Scalable through modularity

## (Some of) The Advantages:

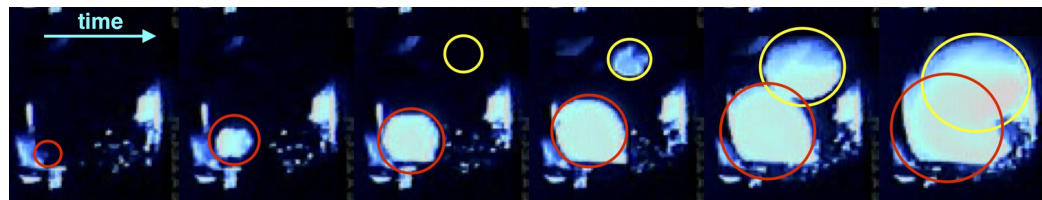
- Water = H and O
- SI & SD sensitivity
- Low thresholds
- Cheap
- NR Directionality?



		$\sigma_{err}$	$p_{KS}$	$\sigma_{KS}$
$^{252}\text{Cf}$	$^{252}\text{Cf}$	1.6	0.116	1.2
Control	Control	1.5	0.088	1.4
$^{252}\text{Cf}$	Control	4.7	0.001	3.1



**Preliminary evidence that radiation (neutrons) freeze supercooled water**



## Non-DM applications:

- CEvNS: NSI
- supercooled water Cherenkov detectors
- supernova  $\nu$ 's

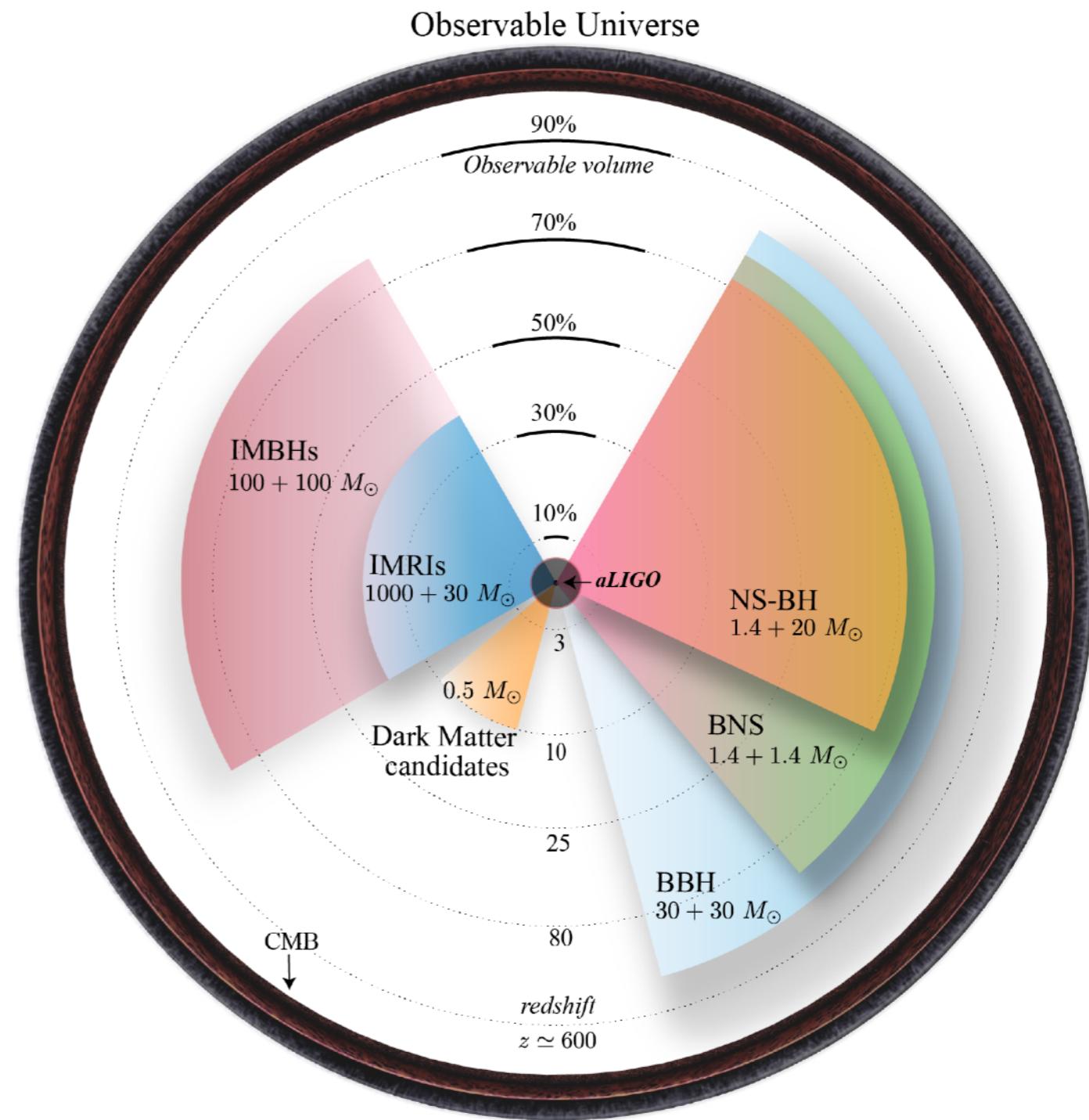
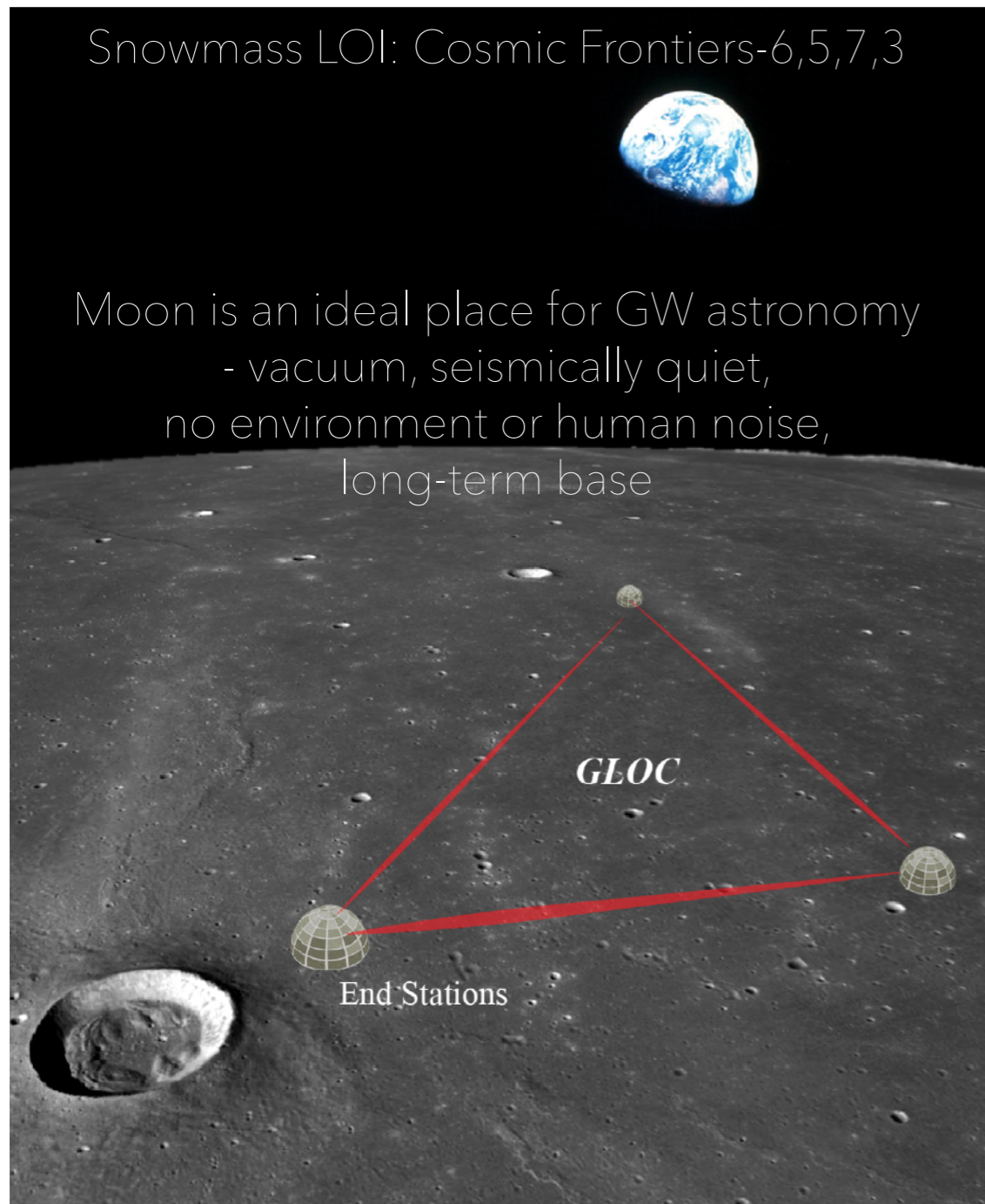
Thank you for your town hall contribution.

The next speaker is Karan Jani

*A deci-Hz Gravitational-Wave Lunar Observatory for  
Cosmology*

# deci-Hz Lunar GW Observatory

Karan Jani (Vanderbilt University)  @astrokjpj



**Science Goals:** Unprecedented cosmological probe, calibration of Type Ia Supernovae,  
Dark Energy & Dark Matter measurements up to redshift  $\sim 10$ ,  
Multi-wavelength tests of General Relativity & Neutron Star equation of state

Thank you for your town hall contribution.

The next speaker is Ferah Munshi

*Testing SIDM with Realistic Galaxy Formation  
Simulations*



# There is no reason to favor CDM once you consider baryons (in small galaxies)

**Can we use galaxy formation simulations to predict an observable that favors a particular dark matter model?**

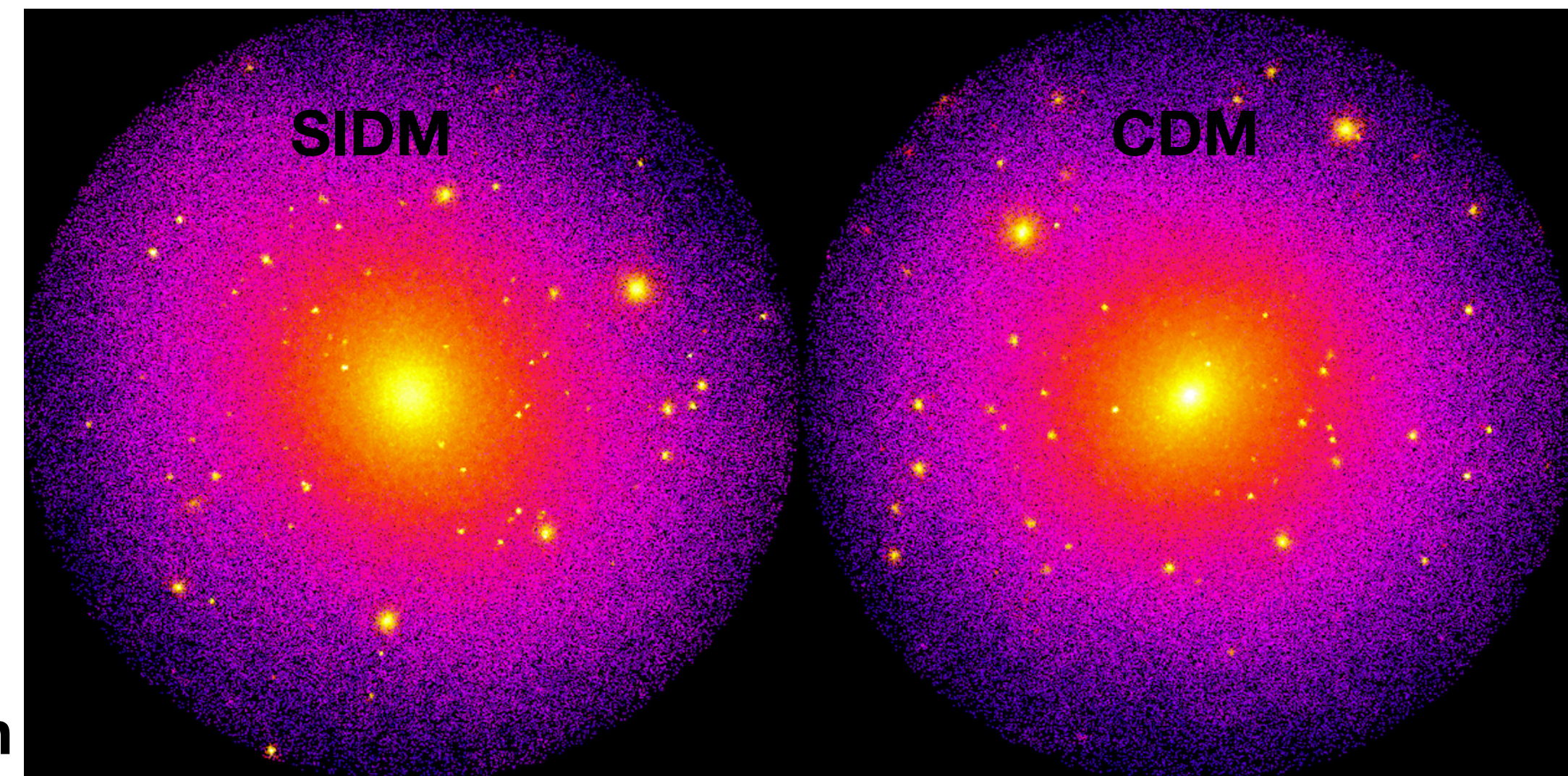
“challenge”	CDM+Baryons	WDM+Baryons	SIDM+Baryons
Bulge-less disk galaxies	✓	✓	✓
The Cusp/Core Problem	✓	✓	✓
Too Big to Fail	✓	✓	✓
Missing Satellites	✓	✓	✓
Missing Dwarfs	✓	✓	✓
Diversity	?	?	✓?

CDM= cold dark matter, WDM= warm dark matter, SIDM= self-interacting dark matter

Observables we will be looking into:

1. Shapes of dwarf galaxies
2. The edge of galaxy formation- which halos host a galaxy?
3. Diversity of dwarf galaxies

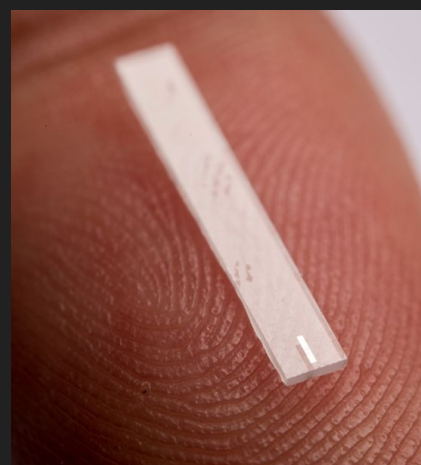
**All of predictions will be testable in the next 10 years with Roman Space Telescope, Vera Rubin Observatory and JWST**



Thank you for your town hall contribution.

The next speaker is Ankur Agrawal

*Superconducting Qubit Advantage for Dark Matter  
(SQuAD)*



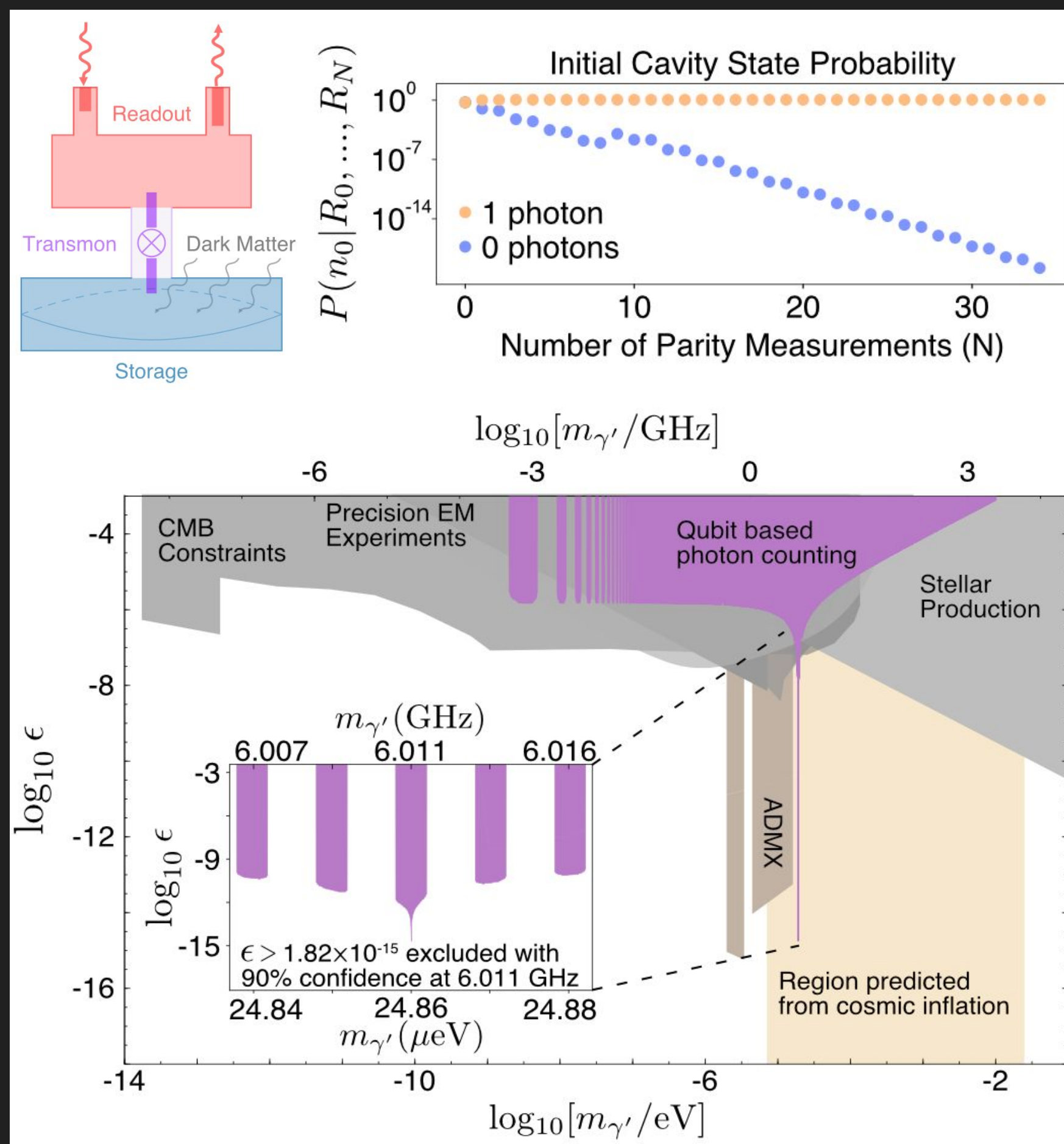
# Superconducting Qubit Advantage for Dark Matter (SQuAD)

Ankur Agrawal, Akash Dixit, Aaron Chou, David Schuster

ankuragrwal@uchicago.edu, avdixit@uchicago.edu



**Photon counting with a qubit sensor reduces backgrounds by a factor of 1300 compared to conventional technology**



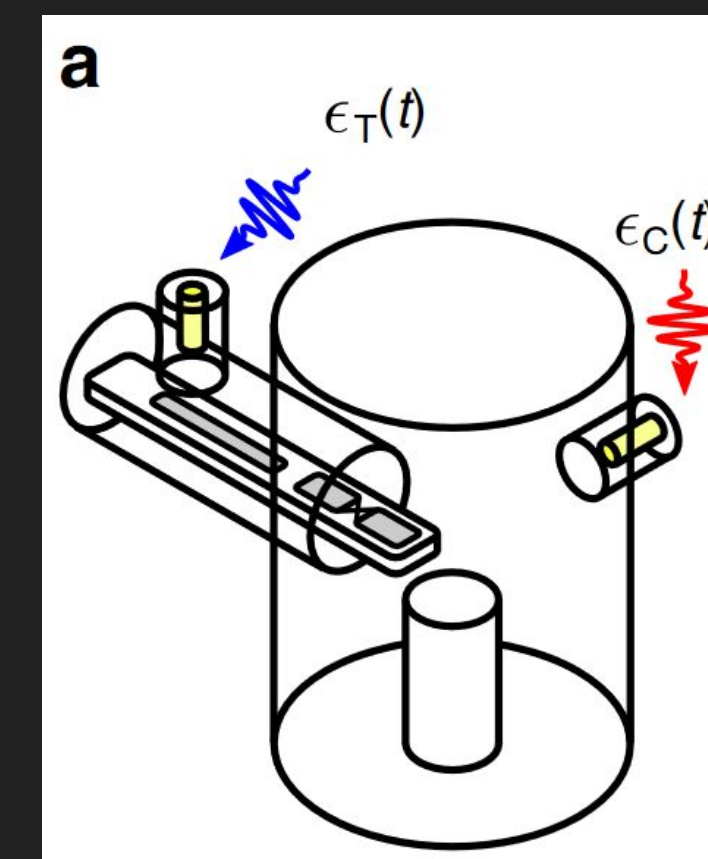
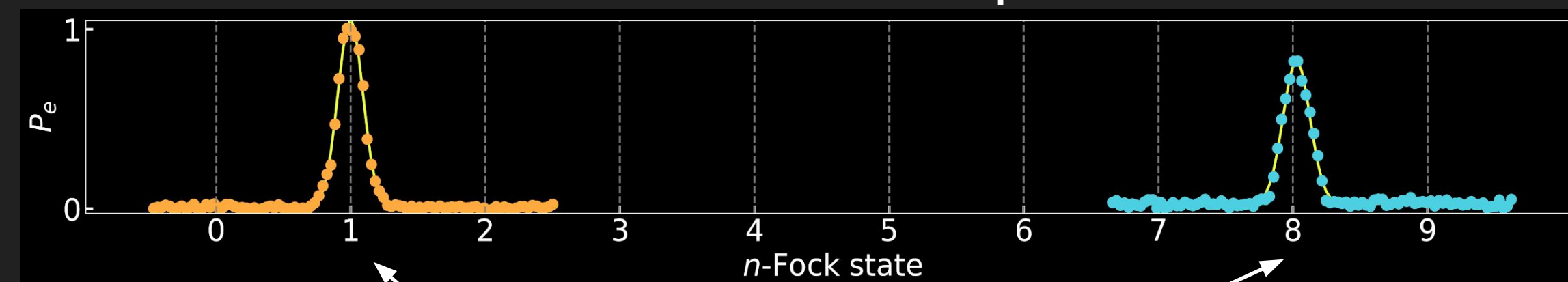
Exponential suppression of readout errors through repeated measurements

World leading sensitivity with only 8 seconds of integration

**Stimulated emission enhances the signal rate**

$$|\langle n+1 | \hat{H}_I | n \rangle|^2 \propto (n+1)$$

**Photon number spectrum**



[Heeres et. al. 2019]

Fock states created by generating qubit and cavity optimal control pulses using ML

Signal enhancement of 10 can be expected

Thank you for your town hall contribution.

The next speaker is Caterina Doglioni  
*Initiative for Dark Matter in Europe and beyond*

## initiative for **Dark Matter** in **Europe and beyond**

<https://indico.cern.ch/e/iDMEu>

The best region to find dark matter is the  
one where more techniques and ideas can

**discover** and **explore** DM

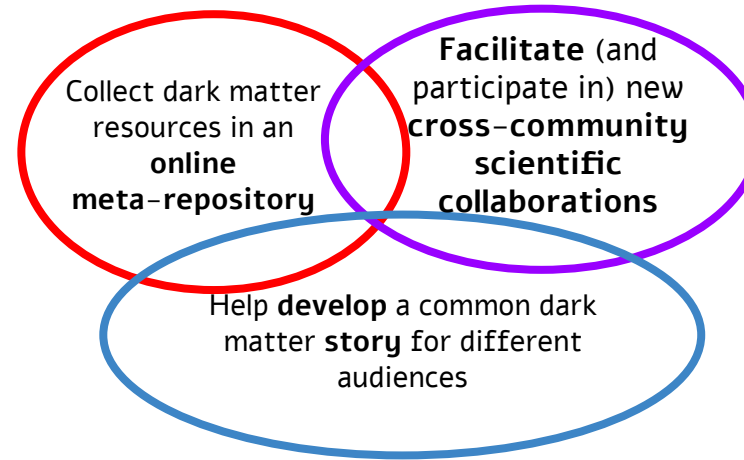


After the European Strategy Update process  
and during a joint ECFA/NuPECC/APPEC  
([JENAS](#)) meeting, a number of DM researchers  
met with similar questions:

*E.g. “what are your assumptions?” “why do you use this  
technique?” “how will findings in your DM research  
impact my DM research?” “where can we meet and  
discuss this topic in depth after this meeting?”*

we realized that there was **no common platform**  
for these discussions or for resource sharing  
→ we decided to start developing it!

### Three connected iDMEu objectives



### iDMEu is **still taking shape**

Meant as a **service** to the community with  
a **lightweight** organization

Helped by a [Task Force](#) put in place by  
ECFA/NuPECC/APPEC, and by reaching  
out to communities towards a **kick-off**  
meeting in Spring 2021

**iDMEu's  
success will lie  
in the success of  
the activities it  
facilitates!**

Thank you for your town hall contribution.